Vol. 20 July, 1926 No. 1

QUARTERLY

OF THE

National Fire Protection Association

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40 CENTRAL STREET, BOSTON, MASS.

National Fire Protection Association

INTERNATIONAL.

Executive Office, 40 Central Street, Boston, Mass., U. S. A.

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The Union.
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Washington Surveying and Rating Bureau.
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Western Canada Fire Underwriters' Association.
Western Factory Insurance Association.
Western Insurance Bureau.
Western Sprinklered Risk Association.
West Virginia Fire Underwriters' Association.
West Virginia Inspection Bureau.
Wisconsin Inspection Bureau.

Over 4,100 Associate Members

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Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

The Lowell department store fire. Five buildings of the A. G. Pollard department store, and the Masonic Temple adjoining, were destroyed at a loss estimated at $1,500,000. See report on page 90.

The Quarterly

Vol. 20 July, 1926 No. 1

The Thirtieth Annual Meeting. Atlantic City again demonstrated her excellence as a meeting place for the N.F.P.A. by registering at the thirtieth annual meeting the largest attendance in our history. The new plan of extending the sessions over four days proved admirable in many ways. Among other advantages it permitted a less-hurried registration; it allowed a half-day for meetings of committees before the convention; and an opportunity for members who always arrive the morning of the first day to make their preliminary contacts and be on hand for the opening session. The behavior of the big new fire boat "Port Houston" was sufficiently impressive to convince anybody she can throw a lot of water, and many of the members got a considerable thrill out of their voyage in the "rum-chasers." The afternoon of relaxation planned by the Marine Committee was interesting in every detail. The program of convention work was exceptionally successful, the discussions being placid and free from excitement with the possible exception of those following the reports of the Electrical Committee and the Committee on Laws and Ordinances. Another year of pretty definite accomplishment has passed into history.

* * * * *

Lowell Takes Her Toll. The Lowells and the Lawrences are old New England families, distinguished even in these degenerate days by poets and college presidents and bishops; and the towns named after them are good enough towns after their fashion. Lawrence was one of the first in New England to respond to the overtures of our field engineers and make a definite move to help herself. She has fire hazards that do not make for a good night's sleep; but she is watching them in a reasonably responsible spirit. Lowell has equal, if not worse, conflagration possibilities. She has one less, however, at this writing than before Memorial Day. The department store of the Pollard Company burned itself on that day and the Masonic Temple for company. The Pollard department store, a menace to the fire safety of the entire city,

was without sprinklers and burned like a straw-board box. It had no more justification for its existence in the heart of Lowell than a small-pox patient at a dinner party. Only by the rarest good fortune half the city did not go with it. The local newspapers are heralding its rebuilding. Lowell is to have a new, up-to-date, "fire proof" department store. This should be a comfort to the people outside Lowell who are assessed to rebuild it. If Lowell herself had to pay the bill her editors might be less jubilant.

* * * * *

Personal Liability Idea Advances. Following the good news that the City of Kalamazoo, Mich., has enacted an ordinance fixing the cost of extinguishing fires upon persons disobeying fire prevention orders and prints this liability on the back of the fire department's inspection blanks, come advices from Cleveland, Ohio, to the effect that last month sixteen suits, asking damages of $150,000, were filed in Common Pleas Court against William C. Morton, owner of the Wellington apartments, East 40th Street and St. Clair Avenue, that city, which burned in 1923. The tenants who have brought the suits charge that the fire was due to the negligence of an employee of the owner.

Cleveland, along with Cincinnati, was one of the first cities to enact an ordinance like that just passed by Kalamazoo. This liability in Cleveland has now been established for a decade and the citizens have evidently become so accustomed to the idea that they are led to act upon their common law rights in the above case. People who burn your property through their negligence are just as liable under the common law as those who smash your automobile; a dozen states' attorneys-general have officially said so. But people seem slow to invoke the law when injured by fire. Cleveland, a leader in the idea of assessment of fire extinguishment costs upon the careless, may by this case serve to emphasize the more general liabilities established by common law.

* * * * *

Philadelphia Is Awakening. The fire loss in Philadelphia last year was $6,710,203. Over half a million of it ($544,542) was not distributed through insurance: it was paid directly by the persons whose property burned. The 1925 loss was nearly a dollar per capita more than the loss of 1924. The fire prevention committee of the Chamber of Commerce is a capable committee and is capably officered. It means to get at the causes of Philadelphia's fires and to work persistently to eliminate them. The need for such work of investigation is obvious when it is noted that out of the 6,363 fires causing the $6,710,203 loss for 1925, the causes of 694, involving an ash-heap of $4,665,491, were unknown. The cost of maintaining Philadelphia's fire department in 1925

was $4,150,070 and the value of her public fire fighting equipment is $2,083,000. When we realize that Philadelphia is not cursed by wooden shingle roofs, and hence is immune from that common cause of conflagrations, a proper organized effort ought to make her reasonably fire safe. She is burning vastly too much in so-called "unit" fires.

The analysis by Girard, the "columnist" of the *Philadelphia Inquirer,* printed in this issue of the QUARTERLY, is interesting, but the pessimism of the opening lines is not warranted. Our field engineers are in close touch with the fire prevention work of the Quaker City and are confident that it is to be continuous, and eventually effective.

Philadelphia's Fire Waste.

By "Girard" in *Philadelphia Inquirer*.

It is certain that after Clean-Up Week there will be just as much dirt in Philadelphia streets.

Also probable that after Fire Week folks will be just as careless with matches as they were before.

As Poor Richard said, everybody applauded his speech about economy and thrift, but at once began to practice the contrary.

Good advice, costing nothing, usually meets the fate of other commodities which cost nothing. Still, our badly kept streets and 6,363 fires in Philadelphia last year are twin indictments of Philadelphia's good sense.

Dirt, dust and gutter filth pile up doctor bills, fill our hospitals, keep the undertakers busy and populate our cemeteries.

And still the people *pay* for clean streets—not just one week in a year, but all the other fifty-one weeks.

Two thousand miles of unclean streets are 2,000 miles of disease breeders, and it will require some harder jolt than a Clean-Up Week to change that fact.

* * * * * *

Our needless fires are as bad as our dirty streets. I do not know which costs the people more.

Nobody can count the cost of one, but fire underwriters know to a dollar the cost of the other.

Philadelphia's fire bill last year was $6,710,000. It was, as I have said, cut up into 6,363 slices.

Our seven fires of over $100,000 aggregated $1,467,000. But it is not the big blaze which lays the heaviest tax upon Philadelphia.

The flock of 6,271 fires, each of less than $10,000 loss, taxed the city $2,975,000, or more than twice as much as the biggest fires.

It is another proof that it is costly to ignore small things.

* * * * * *

Nearly half of America's oil comes from wells which yield only five barrels or less in one day.

The great gushers enrich the few, but it is the vast number of little wells which keep your auto running.

And it is that way with Philadelphia fires. This city has been most fortunate in never having had one really great fire.

Our biggest one in 244 years of history brought a loss of less than $1,500,000.

Compared with the $300,000,000 fire in San Francisco, or even the $50,000,000 fire in Baltimore, Philadelphia's biggest fire was a mere torch. New York, Boston and Chicago have had fires from twenty to fifty times as great as Philadelphia's greatest.

But if Philadelphia has suffered no spectacular blaze, it needlessly taxes itself with thousands of preventable small ones.

* * * * * *

In recent years a strong effort has been made to prevent fires. As in the case of human diseases, it is far cheaper to prevent than to cure.

This city pays in a year over $4,000,000 to its fire fighters and for upkeep of its fire-fighting equipment. Our fire engines are worth $2,000,000.

It is true that modern buildings are the very best fire preventives. Science, backed by hard cash, makes it almost impossible to start a fire in these new structures.

But that costs money, and a lot of it. Still if you ask the owner of a great modern building about it he will tell you that his ounce of prevention, costly though it be, still earns a big annual profit by reducing insurance charges.

* * * * * *

Who starts all these thousands of needless, but very expensive little fires?

The stupid handler of the match wins the blue ribbon. He began 2,200, or one third of all the fires in Philadelphia last year.

A lightning flash looks formidable, even terrifying. But that thunderbolt, loaded with fifty million volts of electric current, is a piker beside the puny match in starting Philadelphia fires.

Ben Franklin did a good job, and one scarcely improved in 175 years, when he invented his lightning rod. I do not know, of course, how many fires by lightning his rods prevent, but I do know that last year only eight fires in this city were started by a flash from the clouds.

And the match 2,200!

Why, even our bootleggers do more damage than all the thunderstorms, since eighteen fires were the result of exploding home-brew stills.

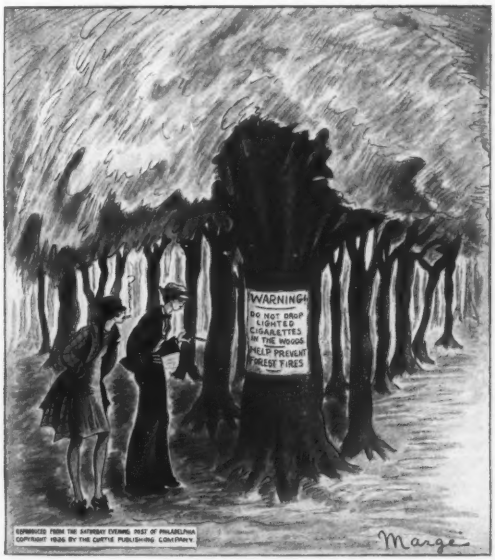
* * * * * *

The thoughtless smoker steps up and gets a yellow ribbon pinned upon his noble breast.

Why? Because he started 270 fires here last year. It is estimated that 100 Philadelphia smokers strike a match every second of every day.

The proportion of careless smokers to the whole number must be small, but even so, our smokers if they scored a zero, could handsomely endow a big hospital in the fires they prevented.

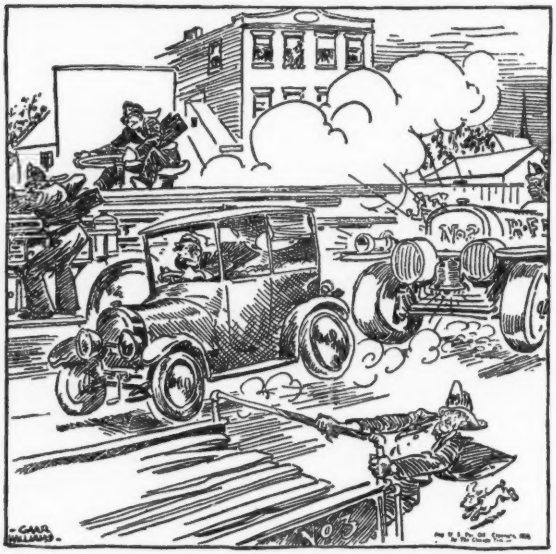
It is figured that we use on an average seven matches a day. Baltimore's $50,000,000 fire was started by a cigarette, but it never got the advertisement accorded Mrs. O'Leary's cow in Chicago.



"Huh! And they call this a free country!"

—Saturday Evening Post.

HOW TO KEEP FROM GROWING OLD



Williams in the Chicago *Tribune*

GETTING BY

Spang in the Montgomery *Advertiser*

Meetings of Executive Committee.

May 10, 1926.

MEMBERS PRESENT.

Rudolph P. Miller, New York, President
Dana Pierce, Chicago, Vice-President
A. M. Schoen, Atlanta, Vice-President
Geo. W. Booth, New York
E. R. Hardy, New York
F. C. Jordan, Indianapolis
S. D. McComb, New York
H. L. Miner, Wilmington, Del.
W. F. Steffens, New York
P. W. Terry, St. Louis
Franklin H. Wentworth, Boston, Secretary-Treasurer.

Business Transacted.

The report of the chairman to the annual meeting was approved, and a vote of appreciation given to the employees of the Executive Office.

The report of the Treasurer was approved.

The report of the New York Finance Committee was accepted and referred to the incoming Executive Committee.

Mr. David J. Price was appointed N.F.P.A. representative on A.E.S.C. Sectional Committee on Safety Code for Conveyors and Conveying Machinery.

The Secretary was requested to send a telegram to Chairman A. T. Bell expressing regret at his illness and hopes for a prompt and complete recovery.

June 29, 1926.

MEMBERS PRESENT.

Dana Pierce, Chicago, President
Allen M. Schoen, Atlanta, Vice-President
H. O. Lacount, Boston, Past President
R. P. Miller, New York, Past President
George W. Booth, New York
George W. Elliott, Philadelphia
H. L. Miner, Wilmington, Del.
W. W. Orr, New York
Hickman Price, New York
P. W. Terry, St. Louis
Louis Wiederhold, Jr., Philadelphia
Franklin H. Wentworth, Boston, Secretary-Treasurer.

Past President W. E. Mallalieu and Chairman A. R. Small of the Electrical Committee were present by invitation.

Business Transacted.

Dust Explosion Hazards: Amendments to Regulations governing Starch Factories.

The annual meeting authorized the Committee on Dust Explosion Hazards to make minor changes as might be necessary in the regulations adopted at Atlantic City. In accordance with this authorization the committee requested that the following revisions in the Regulations on the Prevention of Dust Explosions in Starch Factories be approved.

(Refer to Proceedings, 1925, page 372.)

Par. 16 to be revised to read as follows:

"Door openings to outside unenclosed stairs shall be protected by fire doors, Class D, E or F in accordance with the Regulations for the Protection of Openings in Walls and Partitions Against Fire as recommended by the National Fire Protection Association."

This change does not affect the intent of the original text. It merely clarifies and amplifies it.

Par. 31, first line, add the word "dry" before the words "dust collecting systems". This change is suggested because the rule as now worded applies to wet systems as well as to dry, while the intention is to have it applicable only to dry collecting systems. The revised sentence reads: "Dry dust collecting systems for apparatus ahead of the mill shall be separate from the collecting systems for apparatus after the mills".

Par. 83, second paragraph to be revised to read as follows:

"When extension cord portable lamps are used drop cord shall be approved rubber sheathed cord designated as Type S by and constructed in accordance with Article 603 of the National Electrical Code. The cord shall be equipped with standard terminal fittings. Lamps shall be enclosed in portable dustproof fixtures equipped with proper guards."

This is a minor change and in the opinion of the committee not subject to any controversy.

The amendments were adopted.

A.E.S.C. Project: Regulations governing Fire Fighting Equipment in Metal Mines.

The American Engineering Standards Committee having initiated a project calling for the preparation of a Code on Fire Fighting Equipment in Metal Mines with the following scope:

"Fire preventive measures and minimum facilities and equipment required for fire fighting in metal mines; including water supply, hose, fire extinguishers, sprinkling system, availability and care of oxygen rescue apparatus, fire signals, regulations governing fire doors, fans, control of ventilating during mine fires,"

The American Mining Congress and the N.F.P.A. were invited to serve as sponsors for this project.

It was voted to accept this joint sponsorship.

Members W. H. Blood, Jr., Boston, and George W. Elliott, Philadelphia, were elected to complete the Nominating Committee 1927.

It was voted to hold the thirty-first annual meeting of the Association in Memphis, Tenn., May 9, 10, 11 and 12, 1927.

A *Program Committee* consisting of the President, the Secretary, and the Chairman of the Executive Committee was appointed with authority to add to its number.

A *Press Committee* consisting of Messrs. Hickman Price, George W. Elliott and Allen M. Schoen was appointed with Mr. Price as Chairman.

Items relating to the program were discussed and referred to the Program Committee.

The budget 1926-1927 submitted by the Treasurer was approved.

Mr. Samuel D. McComb was appointed Chairman of a Committee created to solicit funds in New York in aid of the field engineering service, with authority to appoint the committee in conference with the Secretary.

Chimney Ordinance; National Board of Fire Underwriters:

It was voted to adopt the revised ordinance of The National Board of Fire Underwriters for the construction of chimneys, the National Board being requested to consider certain minor changes suggested by the Executive Office, N.F.P.A.

Status with A.E.S.C. of 1926 Supplement to the National Electrical Code.

The following report on this subject was submitted by the Chairman of the Electrical Committee:—

> As instructed by the Executive Office, application was made to the A.E.S.C. for approval of the above. This was in accordance with the action of the 30th annual meeting when the supplement was adopted as an N.F.P.A. Standard. Following its regular procedure the A.E.S.C. office had a Special Committee of Review appointed; the report of this Special Committee to the June 10th meeting of the Main Committee A.E.S.C. is as follows:

American Engineering Standards Committee
29 West 39th Street, New York.

MC 482
6-10-26

June 9, 1926.

To the American Engineering Standards Committee:

"National Electrical Code"

Your Special Committee recommends as follows in regard to the approval of the "National Electrical Code", submitted by the National Fire Protection Association as sponsor:

> The special committee believes that the action of the sectional committee was taken by a substantial majority and appeared to represent the

best conclusion attainable at the time and under the conditions obtaining in this field.

In the hope, however, that a closer approach to unanimity may be obtained it is recommended that the A. E. S. C. refer the code back to the sponsor with the request that an attempt be made to secure a more general agreement, and that this reference be made without prejudice to further consideration of the present form of the report by the A. E. S. C. at its September meeting in case a greater degree of unanimity is not secured in the meantime.

It is further recommended that the A. E. S. C. agree that in the meantime the sponsor may *on its own responsibility** issue the present form as a tentative version for field application, but subject to further consideration and possible revision.

Your committee believes that the personnel of the sectional committee was representative and adequate, and that the action of the sectional committee and of the sponsor was entirely regular.

The above actions were by unanimous action at a meeting held today.

(Signed) Special Committee on Approval
by A. W. Whitney, Chairman.

*NOTE: Submitted to A.E.S.C. 6/10 amended as indicated.

After consideration of this report it was voted:—

(a) That the Executive Committee has no authority to reverse any action taken by the Association.

(b) That the Secretary be requested to recommend to the National Board of Fire Underwriters the adoption and publication of the 1926 amendments as a supplement to the National Electrical Code.

Proposed International Standards Association.

It was voted to advise the Secretary of the Fire Group of the A.E.S.C. that in the opinion of the Executive Committee the N.F.P.A. is not at present interested in the formation and operation of an International Standards Association so far as the activities of the Association itself are concerned.

Respecting the recommendation of a member for the preparation of a suggested form of law or ordinance governing the installation of first aid fire appliances it was voted that the present N.F.P.A. regulations on this subject are considered adequate.

The recommendation of a member that the committee advocate a change of the Association's name to National Fire Prevention Association was laid upon the table.

A recommendation that the Association prepare standard regulations governing the storage and handling of flammable liquids was referred to the Secretary.

American Engineering Standards Committee Appointments.

The appointment of A. R. Small as principal and G. S. Lawler as alternate representatives of the Fire Protection Group upon the Electrical Advisory Committee of the A.E.S.C. was confirmed.

C. J. Krieger was elected representative of the Association upon a temporary committee of the A.E.S.C. appointed for the purpose of reviewing the N.F.P.A. Standard on Threads for Small Hose Couplings which has been submitted to the A.E.S.C. for registration as an existing standard. According to the usual procedure such committees investigate the method of preparation and status of the Standard under consideration, report to the A.E.S.C. and are then discharged.

New Committees.

The Executive Office was authorized to create the following two new committees in conference with the members elected as their chairmen, viz.:

(a) Garages, H. C. Newell, New York, Chairman.
(b) Zoning, Rudolph P. Miller, New York, Chairman.

N.F.P.A. Committee Appointments.

Existing committees were reviewed in the light of the recommendations of their chairmen, and changes in the personnel of the same and the rosters of the two new committees will appear in the forthcoming Year Book.

New York City's Housing Problem.

The Massed Frame Dwelling Fire Hazard.

The January QUARTERLY (Vol. 19, No. 3) carried an editorial on "The Coming Conflagration," which stated that "New York is building for a conflagration, perhaps the greatest in all history."

A review of items and events that bear upon this New York situation is here presented. These plain facts fully sustain the statement of that editorial.

On April 14, 1925, the Suburban Division of the New York Fire Insurance Rating Organization issued a report on "Mass Frame Dwelling Construction in Queens County, N. Y." This report points out the serious conflagration hazard. A group of recommendations, "To reduce to a minimum the peril of a widespread conflagration" closes with "It is possible that state or municipal regulations may be adopted restricting such mass frame construction in the future."

The April 30, 1925, issue of *The Insurance Field* carried an article headed "Biggest City Offers Biggest Frame Conflagration Hazard." The article points out that "In the face of a nationwide agitation aiming at the reduction of fire loss and promotion of fireproof cities . . . New York has become the greatest builder of forests of wooden buildings. In Brooklyn and Queens Boroughs alone $150,000,000 yearly of new frame construction is built.

"This annual increase adds a serious potential hazard that compares with actual past conflagrations as follows: more than half the San Francisco earthquake and fire; equal to the combined Chicago and Boston fires of 1872-73; ten times the Salem fire of 1914.

"Construction and more construction is the way to provide housing. But new construction of a character and design to invite destruction on a prodigious scale may turn out to be a remedy worse than the disease. Not only may the relief be merely temporary, but multitudes may be rendered homeless without warning. Within the confines of Greater New York have been erected, within the past few years, nearly a billion dollars' worth of frame dwellings, with wooden shingle roofs predominating and other fire hazards that provide a nest for hatching a conflagration that may easily dwarf any predecessor in the world's history."

The article gives facts and figures from public records that fully sustain the above warning.

The *Spectator* of May 14, 1925, in an able editorial discusses these conditions and says, "If the building business could be personified, it would have to be labeled a Dr. Jekyll and Mr. Hyde industry. . . . The remarkable progress and highly meritorious progress in construction of the fire limits section of the city is compared with thousands upon thousands of homes, built from the cheapest materials, of the flimsiest construction. If this encircling of the Metropolitan District is not a menace to life and property then it would seem that life and property cannot be menaced."

The New York State Housing and Regional Planning Commission, whose personnel is composed of business men, architects, and economists, has been actively interested in these conditions. In November, 1925, this commission held hearings to gather facts for a report to the State Legislature on "Rent Law Extension." The hearings of November 13 and 16 were given over entirely to the fire hazard and the startling character of "The Fire Menace" was thus first officially shown to the public.

How great the public interest is was shown by the manner in which the Metropolitan newspapers handled the testimony. More than a score of front page, many inside pages and a dozen or more editorials were devoted to the testimony given before the commission by the experts from the fire department, the architects, fire insurance engineers and company presidents, and other business men.

The utterly uneconomic character of the development, even though no fire hazard existed, was likewise shown. A careful reading of the text of the testimony given fully warrants the nature of the headlines that topped these newspaper reports. A few of these headlines follow:

(Newspapers of November 13, 1925, evening)

"FIRE MENACE IN BROOKLYN AND QUEENS WORST IN WORLD HOUSING COMMISSION TOLD"

(*Brooklyn Standard Union*)

"WARN OF BORO RISK AT RENT HEARING"

"Witnesses Predict Greater Disaster Than Chicago's Unless Frame Houses Are Razed—Urge Brick Construction" (*Brooklyn Daily Eagle*)

"WORLD'S WORST FIRE THREATENS QUEENS RENT WITNESS SAYS"

"Investigators Tell Commission Fire Department Could Not Cope With Blaze in Crowded Frame House Sections" (*New York Evening Post*)

"RENT COMMISSION WARNED OF PERIL OF CONFLAGRATION"

"Experts Condemn Spread of Frame Homes in Queens and Brooklyn" (*New York Sun*)

"MILES OF FIRE PERIL IN QUEENS WOODEN HOUSES"

"Experts Tell Housing Commission Flimsy Buildings Should Be Razed—Called Standing Danger" (*New York Telegram*)

"BIG FIRE MENACE IS SEEN IN WOODEN HOUSES"

"Robert Adamson Tells of Destruction from Similar Conditions" (*New York World*)

"GRAVE FIRE RISK IN QUEENS BORO RENT COMMISSION TOLD"

"New Flimsy Wooden Houses Jammed Together Block on Block" (*Brooklyn Times*)

All of the morning papers of November 14 carried even more complete and startling stories and the editorials began to appear. We give a few excerpts of the headlines only: "Fire Menace Seen in Rush of Building Homes in Queens. Witness Calls Speculative Frame Dwellings a Scourge" (*New York Times*); "Fire Peril Stressed at Housing Hearing" (*Journal of Commerce*); "See Aldermanic Move to Extend Fire Limits. Would Prevent Further Construction in Outlying Districts of Frame Houses of Type Denounced by Witnesses Before Commission. Ex-Fire Commissioner Adamson, Architects, Insurance Men and Other Experts Point Out Danger of Conflagrations. Officials Place Failure to Make Fire Limits City Wide on Aldermen Themselves" (*Brooklyn Standard Union*). "Miles of Homes Called Fire Menace. Experts Tell Housing Commission Queens Faces Catastrophe Perhaps as Great as That of Chicago. Danger of Entire Area Becoming Gigantic Slums Cited at Rent Hearing" (*Herald-Tribune*).

In an editorial, the conservative *Evening Post* says on November 14: "The hasty building of a great number of flimsy houses, creating a fire menace that will last for years, is the worst possible way of meeting the housing problem which now confronts us."

The *Brooklyn Times* ran a five column wide cut showing tens of thousands of these crowded wooden houses each upon a 25-foot lot and but three to six feet apart.

A notable fact is the manner in which both the city editor and the editorial writers handled the subject. There was a complete acceptance and frank facing of the unquestionable facts and what these facts mean. But one conclusion can be drawn from a careful reading. The conclusion that New York has committed and is continuing to commit the most colossal blunder in construction ever known to the human race.

Aroused to action by the facts made public, the New York Chapter of the American Institute of Architects met and passed unanimously a resolution deploring these conditions and asking the city officials to extend

the fire limits co-extensive with the city limits. The Brooklyn Chapter did likewise.

On December 14, Mayor Walker met with the Committee of Architects and asked their aid and advice in correcting these conditions and other laxities of the Building Code.

On February 2, 1926, Mayor Walker appointed a committee of thirty-seven prominent citizens to "Guard the City from Disaster." The committee is to consider plans for protecting human life from all possible emergencies—fire, flood, famine, earthquake, explosion and tornado and from the destructive panics which ensue in such happenings.

Public interest has been unquestionably aroused. When a fire burned three and badly damaged two more houses in Jamaica section of Queens on March 3, 1926, in less than ten minutes, the Civic Organizations of Queens arose with demands for better protection. On March 22, eight more houses burned before the fire department could reach the spot.

The *Editor and Publisher,* a professional journal that reaches practically every newspaper in the United States, gave space and comment to this condition in December, showing cuts of the frame built section and stating that such conditions were at once a menace to the welfare of the cities and to the forest supplies of the United States. Again in April, 1926, this journal commenting on this New York situation states, "No such outburst of public interest can go unheeded. It is believed by the groups named that correction will be secured. While there is no thought of effort to save the forests, there is a manifest determination that it will be unwise to burn the forests in the form of square miles of city dwellings."

On May 6, the New York State Chamber of Commerce passed resolutions asking the passage of an ordinance, now in committee, to prohibit wooden shingles and also asking the city officials to extend the fire limits.

On May 14, Mayor Walker appointed a larger committee, composed of 470 leading citizens, whose duty was to be to plan the future growth of the city. This larger committee is the outgrowth of the earlier committee. On May 21, Mayor Walker met with this committee and told them that "New York Jest Growed Like Topsy." He stated that distribution of population and decent living conditions were fundamental needs. A subcommittee on Housing was chosen to make a survey and recommendations.

End These Menaces!

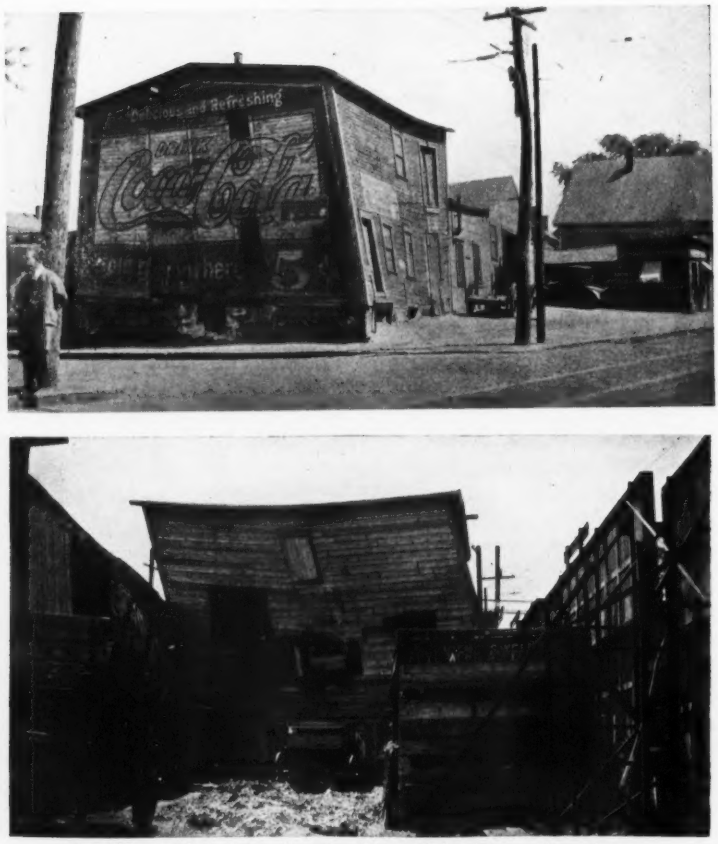
Providence Evening Bulletin.

Providence Progresses.

The high point of attack of the field engineering service of the National Fire Protection Association is the abolition of the conflagration hazard. Owing to building methods during the past fifty years there is not in North America a single city in which there is not a daily and nightly hazard of a sweeping fire. Individual owners may do their utmost to protect their own properties, but unless they are located at points remote from conflagration areas they are not immune from outside fire attack. Over and over again this fact has been demonstrated in the long list of conflagrations that have decimated American cities in the last two decades.

Unit fires will continue indefinitely, and they will continue, through the distribution of their cost by the underwriters, to lay our people under heavy toll. But the sweeping fire can be abolished, and once its significance can be forcibly brought home to the influential people in a community, it will be. Communities cannot, however, be aroused even to protect themselves, by the admonitions of private or commercial interest. The American advertising instinct has got our people into a state of mind in which they suspect propaganda in almost everything. Our cities are responding to the urgings and persuasions of our field engineers because of their disinterestedness. We can call a spade a spade because we have engineering knowledge and experience behind us and are not commercially timid. We have nothing to sell. Nobody can spoil our market. We can openly and honestly condemn anybody whose attitude or action is anti-social, and we can lift into the limelight and publicly defend the humblest man on a city job who is trying to do his duty. The fire commissioners, fire chiefs, building inspectors and other officials responsible for public safety are now taking courage and daring to act for the public in controversial matters against influential selfish interests, because with our engineers in the field these officials cannot be successfully maligned or misrepresented. An intelligent public opinion must be created in a city before any definite results can be expected from the attempt to eliminate conflagration hazards. The owners of fire traps who will not meet their civic duty without prodding must be made to realize they are in danger of local unpopularity.

There are but two things to do to a building which menaces a city or a neighborhood; protect it so that it cannot start a conflagration or tear it down. If it is valuable or useful enough to retain it can be rendered practically harmless to its neighbors by installing automatic sprinklers; if



Conditions Found by the Providence Fire Prevention Bureau.

it is not valuable enough for this its continued presence as a menace to the fire safety of other, better, buildings cannot be defended.

All this is preliminary to the setting out of the present interesting campaign in Providence, R. I., to reduce the danger of sweeping fires. This campaign is admirably dramatized by the accompanying cartoon from the *Providence Evening Bulletin.* The Providence editors have been helpful ever since our field engineers first entered Providence two years ago. At that time there was practically no fire prevention movement there, but the best citizens and city officials at once responded interestedly to our work. The line of development was the extension of the personnel of the fire prevention committee which had been functioning in the promotion

of fire prevention day observances, and its transposition into a real working body through continuous active contact with the fire commissioners and fire chief. The fire prevention bureau of the fire department established a few months ago and equipped with funds to do its work is one of the results. Its inspection work has been continuous and efficient and public education of a real sort has followed its inauguration. Thus Providence has reduced her common hazards by proper surveillance and has made progress in developing a state of local fire consciousness that will support the fire inspection bureau in a campaign for the elimination of conflagration breeders. When a city gets as far as this she is on the way to fire safety.

Current activity in this matter is indicated by the following news article clipped from a recent issue of the *Evening Bulletin*:—

FIRE PREVENTION BUREAU CONDEMNS WHARF BUILDINGS

Two Dorrance Street Waterfront Structures Classed as "Menaces Endangering Lives of Firemen."—One, Without Roof, is Not in Use.

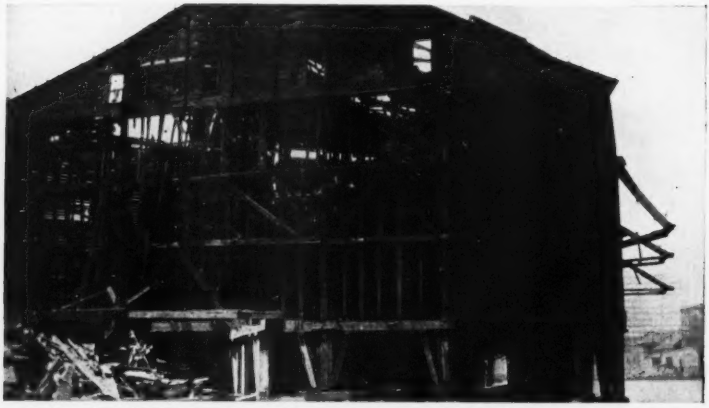
Consistent with its programme to reduce fire hazards and to do away with tottering old structures which constitute a menace to the lives of the firemen, the Bureau of Fire Prevention has called the attention of the Inspector of Buildings to another site considered worthy of municipal action.

Reporting to the Fire Commissioners, who in turn passed the opinion over to Spencer B. Hopkins, the bureau sets forth that two buildings on the Dorrance street wharf are "fire menaces, endangering the lives of firemen." One, on the south end of the wharf, is not being used and formerly served as a coal pocket. It is about 75 feet high, has no roof and no covering on the west and south sides. It is out of plumb in all directions, the bureau claims.

The other building, on the east side of the wharf, is used as a coal pocket and as a depository for bulk salt unloaded from vessels at the pier. They are owned by Harry C. Clark of 220 Dyer street.

While the adverse reports continue to come in, the Inspector of Buildings and the City Solicitor's office are at work on the business of getting sufficient information to start a test case. If the city is triumphant in establishing a precedent with regard to the enforced razing or repairing of one of the structures inspected by the Bureau of Fire Prevention, it is expected that the bureau will undertake a more rigorous campaign to do away with the fire menace.

It will be observed that the Bureau of Fire Protection has not the power to compel the razing of fire traps: it must act through the building department which, in the opinion of the city solicitor, has the power. This power not having been exercised by the building department until the creation of the Bureau of Fire Protection and its educational activities revealed it, the authorities believe the public's rights should be demonstrated by a test case in the courts. The *Evening Bulletin* commented on this matter as follows:



An abandoned coal pocket on a piece of wharf property where the biggest fire Providence had known in years occurred about three years ago. The ruins of this fire were never cleared up and the unburned structures are in a disgracefully dilapidated condition. This structure of rotted timbers badly exposes a big lumber yard and several oil storage tanks.

Testing the Building Law.

A test case, it is announced, is to be pressed at once by the city to determine its authority under the building law to order the repair or razing of structures the condition of which constitutes a menace to public safety.

Several weeks ago a survey by the Bureau of Fire Prevention revealed a number of such buildings in the city. Some of them were declared to be in so serious a state of disrepair as to be unsafe even for a person to enter, while others were held to be likely to collapse. Almost without exception they were found to be fire hazards of a peculiarly dangerous type.

One of these buildings has now been selected for a test of the law. Notice will be served upon the owners that they must either repair the structure to make it safe or else tear it down. If they refuse or neglect to comply with the order, then the building will be surveyed by three disinterested citizens. If the latter pronounce it unsafe and the owners then do not comply with the city's order within three days, they are liable to a fine of $50 a day for each day's delay, unless in the meantime they have appealed to the Superior Court for a jury trial.

The law seems reasonable alike to the property owner and to the public. The city's legal department declares it gives the municipality ample authority to remedy an intolerable condition. If the test case proves successful, it should be followed by a campaign by the Inspector of Buildings (already long overdue) to end all similar menaces to which the Bureau of Fire Prevention has called attention.

For the purpose of illustrating this article, H. L. Bond, field engineer took some photographs while in Providence and after his return to the office received the following letter from the Chairman of the Board of Fire Commissioners:—

Three views of a building situated on the square formed by the junction of Westminster Street and Cranston Avenue, Providence. The Bureau condemned this building, a huge frame 3 and 4 story structure extending through an entire block. Buildings surrounding this one are in not much better condition. Demolition of this building began immediately after these pictures were taken.

BOARD OF FIRE COMMISSIONERS
9 Exchange Terrace
Providence, R. I.

June 29, 1926.

National Fire Protection Ass'n,
40 Central St.,
Boston, Mass. Attention Mr. H. L. Bond:

Gentlemen:

I am enclosing herewith clipping from the *Providence Journal* which may be of interest to you in connection with the photographs which you took of the old buildings which were inspected by the Bureau of Fire Prevention and pronounced unsafe and a fire hazard. These reports were made to the Board of Fire Commissioners, under which the Bureau of Fire Prevention was organized the first of this year, and by the Board transmitted to the inspector of public buildings with recommendation that the buildings be razed. There was some delay in that office owing to a question of authority to carry out these recommendations. The city solicitor's office, however, considering the matter advised the inspector of buildings that he had the necessary power to order the buildings removed and work has now been started looking to the elimination of these structures. This work is still going on and by the time the Bureau has rounded out a year of activity the Board of Fire Commissioners expect that further progress along this line will be made. The Board is well pleased with the work of the Bureau and feels that it has already proved its efficiency and value to the community in safeguarding the public against the danger from fire, not only that which might originate in these dilapidated frame buildings but from the careless storage of waste material, flammables and explosives.

Yours very truly,
BOARD OF FIRE COMMISSIONERS,
Everett J. Horton, Chairman.

The article enclosed by commissioner Horton follows. It indicates that the anticipated case in court did not materialize, the owner of the property having decided not to contest the matter.

ALL OWNERS ABIDE BY RAZING ORDERS

Five Large Pieces of Property to Be Cleared of Old, Tottering Menaces

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WORK ALREADY STARTED

Prospects of Test Case Dwindle as Lone Opposer of Edict Decides to Tear Down Condemned Structures

The death knell of tottering old buildings having been sounded by the Inspector of Buildings, Spencer B. Hopkins, five large pieces of property in this city are either in the process of being torn down or will be torn down in the near future as the result of the campaign of the Bureau of Fire Prevention to rid Providence of its fire menaces.

The more important of the structures ordered torn down and their owners are as follows: Frame building at 19 Adelaide avenue, owned by Mayor Leavitt; frame and brick structures at 65 Charles street, Bank street and over the river, owned by Henry C. Clark; frame structures at 119-121 Richmond street, owned by Harry C. Calef; frame building, corner Friendship and Garnet streets, owned by Cosgrove estate; two frame buildings, corner West Exchange and McAvoy street, owned by Andrew B.

Keily; frame buildings at 819-821 Westminster street and 396 Washington street, owned by John C. B. Woods.

All of the above owners have acquiesced in the Building Inspector's ruling. There are several smaller buildings, shacks and barns in addition to the above list which have been ordered destroyed.

For several days it appeared that a test case would be tried in the courts to determine whether the city could legally destroy, or order destroyed, buildings without the consent of the owner. The only recalcitrant owner, however, appeared at the Inspector of Buildings office yesterday in company with a building wrecker and gave notice that he intended to obey the order of the city to tear down waterfront property considered a fire menace by the city. The owner in question asked the Building Inspector that a new inspection be made in the hope that some of the buildings could be repaired and saved. Mr. Spencer said that he would give the matter consideration.

As building inspectors are making a thorough survey of the city in collaboration with the Bureau of Fire Prevention, to weed out fire menaces, it is probable that many more buildings will receive their death verdict. In some cases, real estate men and attorneys believe, the owners will take exception to the city's ruling that the building in question is a fire menace or a menace to human life. The result will be a court case if the parties are unable to come to an agreement.

If the experience of other cities is any guide to an opinion there is no doubt that the citizens of Providence have an indisputable right to protect their lives and property against such a menace as the buildings referred to in the *Evening Bulletin* news item. Nevertheless a test case will be valuable not only to still further strengthen the arm of the fire authorities, but to serve a valuable educational purpose. The more newspaper publicity it receives the better, not only for Providence but for other cities which may be inspired to awaken from their lethargy and follow her example.

Memphis Scores One.

In the southern section of the city of Memphis there has stood for many years a huge wooden structure, alongside the St. Louis and San Francisco Railroad, endangering the buildings of that company and more and more the city of Memphis itself as buildings in that section have multiplied and the danger of a sweeping fire has thus been increased. The use of the structure in question has been confined in recent years to the periodical storage of cotton, protecting the cotton from the weather but endangering its safety from fire. The local appellation of the building has been the Old Rail and River Terminal Warehouse. Its huge dimensions and its flammable character are indicated by the accompanying photographs.

Following the inauguration of our field engineering service in July, 1924, our first visit was made to Memphis in December of that year where we were received with exceptional cordiality by the city officials and the officers of the Memphis Safety Council and Chamber of Commerce. A second visit in March, 1925, cemented the original friendly contacts and relations. An unusually competent fire prevention campaign was first undertaken under the direction of the Safety Council with the city officials actively co-operating, and every public opportunity was afforded us to aid in stimulating and creating further fire prevention consciousness and activity. At our first visit one of the special hazards discussed was a large hospital with brick walls and wooden interior. At our second visit contracts had been let for equipping this hospital with sprinklers, a splendid accomplishment by the local leaders in fire prevention effort.

At this time among other hazardous buildings passed in review was this old rail and river terminal, which had for years been a subject of uneasiness to the Frisco line officials, and to all others who realized that if this old building once took fire with a brisk south wind blowing a serious Memphis conflagration was reasonably certain. Considerable N.F.P.A. correspondence on this subject with the city officials and officers of the Chamber of Commerce followed, and when our field engineer, Percy Bugbee, visited Memphis in the spring of this year a visit was made by the fire prevention group to the property and the feasibility of its early destruction discussed. The following letter was subsequently received by the N.F.P.A. executive office:

CITY OF MEMPHIS.

Memphis, Tenn., March 29, 1926.

Franklin H. Wentworth, Secretary,
National Fire Protection Association.

Dear Sir:

If you will send us a copy of the report of your field engineer on Memphis conflagration hazards as soon as you get it, I will undertake to rectify such conditions as can be reached either under the law or by persuasion.

Yours very truly,

THOS. H. ALLEN,
Vice Mayor and Commissioner of Fire and Police.

Following Commissioner Allen's letter came another on this subject from the Memphis Chamber of Commerce, dated April 13, 1926, reading:

"I have received and noted with very keen interest your letter of April 8th, enclosing copy of communication to Commissioner Allen of the same date.

It will be my purpose to follow this matter through the Safety Council and endeavor to have the Conflagration Hazards Committee vigorously go after the matter brought out in your letter to Commissioner Allen.

In this connection you may be interested to know that work has already been started toward demolishing the old Rail and River Terminal Warehouse Building adjacent to the Frisco property. I am having photographs made of the building as it originally stood and also will have pictures taken after the building has been completely torn down. We will send these photographs to you as evidence that we are going to keep our promise in this matter.

C. M. ANDERSON,
Executive Director."

The photographs accompanying this review are the ones contributed by Mr. Anderson.

Memphis is especially happy in the character of her official family at this time. Her mayor, a former president of the local credit men's organization, has obviously the conservation consciousness; her fire and police commissioner is a distinguished engineer; her fire chief, her salvage corps chief, and her fire marshal are all earnest and capable men; and the managing director of the Chamber of Commerce is the former Safety Council manager whose experience and energy initiated the present forceful campaign for the fire safety of the city.

It is due to the splendid co-operation of these men that we are able to objectify this specific instance of field engineering success. It may seem a modest accomplishment in the face of a yearly national ash heap of $500,000,000. But it is one step of the many we must eventually take toward our final goal. The destruction of Memphis by fire would be a grievous blow to the nation. She still has conflagration breeders that may strike at her heart through the right kind of a fire on the right kind of a night. But in South Memphis, alongside the Frisco tracks, there is now a fair field in which a conflagration will not start.

Photo from C. M. Anderson.

Memphis Rail and River Terminal Warehouse.

1. Before demolition was begun.

Photo from C. M. Anderson.

Memphis Rail and River Terminal Warehouse.

2. Demolition begun. See workmen on roof. Note serious exposure of old warehouse to adjoining building from the roof of which this view was taken.

Photo from C. M. Anderson.

Memphis Rail and River Terminal Warehouse.
3. Progress in demolition.

Photo from C. M. Anderson.

Memphis Rail and River Terminal Warehouse.

4. The old fire trap brought to earth. See Frisco train alongside debris with flat-car ready for another load. Frisco shops in background now relieved of a constant fire menace.

Photo from C. M. Anderson.

Memphis Rail and River Terminal Warehouse.

5. Progress in clearing away. Note how the old terminal constantly exposed cars of merchandise and the loading sheds of the Frisco Railroad.

Photo from C. M. Anderson.

Memphis Rail and River Terminal Warehouse.

6. Not much of it left. Note the grasses which grew up to the side of the old warehouse and which might easily have been ignited by a spark or cigarette butt, thus communicating fire to the building itself.

The Awakening of Chelsea.

The city of Chelsea, Massachusetts, with a population of nearly 48,000 and a property valuation of over $50,000,000, is a rapidly growing community of 200 industries, large and small. Yearly the products of these industries amount to more than $33,000,000, and during the same period their payments to wage earners exceed $8,000,000. The people of Chelsea point to these signs of industrial activity with a justifiable pride. They point also to the sound condition of their nine banks; to their busy thoroughfares; to the well-kept beauty of their municipal buildings and grounds; to their Naval and Marine hospitals, their Soldiers' Home, and their new Bellingham Hill Hospital commanding its fine view of the ocean and surrounding country. They speak glowingly of the efficiency of their police and fire departments, of their schools and teachers, and of the extensive system of supervised playgrounds which they maintain for their youth. They have the right to be proud of these things, for they are achievements which directly reflect the fine community spirit which prevails.

But in early 1924, the eyes of the country were not turned on the civic virtues of Chelsea, but were concentrated with growing wonder and alarm on her disgraceful yearly record of property loss by fire. All the goodness in the little city was overshadowed by the smoke of her carelessness. The nation well remembered that in 1908 Chelsea was swept by a conflagration which destroyed nearly $16,000,000 worth of property, but it appeared that Chelsea had forgotten. What was the matter with the city? Where Chelsea should have been aware of her grave responsibility to the country because of her 1908 exhibition, she appeared to be entirely oblivious to the fact that she was virtually "on trial" before the nation. The figures which so aroused the general ire in 1924 were these:

Year	Total Loss	Loss per capita	Fire Alarms
1919	$431,557.00	$9.59	383
1920	296,258.00	6.58	388
1921	262,063.00	5.24	481
1922	239,261.00	5.20	627
1923	498,460.00	10.61	774

Here was an average annual per capita fire loss of $7.44 over a five year period!

Apparently this shameful record was allowed to continue unchallenged by the city because of some other reason than ignorance of the

situation; for Fire Chief David M. Hudson had repeatedly called attention to the serious conditions which made this situation possible. His 1923 report to the city was typical. Here are a few extracts therefrom:

"Two sections of our city contain all the elements and fundamentals in the spreading of fires of great activity. These two sections, possessing such dangerous conditions, so plainly evident, may at any moment have fires of such great magnitude that their control would be decidedly uncertain. A part of our waterfront, so called, . . . is of such a character . . . as to cause much anxious solicitude to our fire officials.

"Our rag storage district is the other and greater danger. Being on the windward side of the city it presents such distinguishing features of conflagration possibilities as to make it plainly evident that our greatest fire may start here at any time. It presents, also, a problem in fire extinguishment that, owing to the great amount of quick-burning materials to be found in this district, cannot be solved easily or inexpensively. This menacing condition is one that has been gradually growing for many years. It has not come into existence suddenly or unexpectedly. It is the natural product of years of apathetic indifference to its potential fire peril.

"With a fire hazard unequalled in any city we should be equipped with the most efficient water-throwing apparatus if we are to hope for a continued successful defense against the numerous outbreaks of dangerous fires in this district.

"At a number of extremely menacing fires I have marveled at our fortunate escape from a conflagration.

"Nothing but the strenuous energy displayed by the manual force of the department on those hard-fought occasions made success possible."

This published report, which should have shaken the people of Chelsea out of their lethargy, had no appreciable effect on them. Only a small portion of the people of a city read the reports of their officers, and few of those who do read them are moved to act except where their immediate economic interests are involved.

On July 1, 1924, the National Fire Protection Association inaugurated its field engineering service, selecting for first investigation a list of twenty cities having indefensible fire records. Chelsea was conspicuous among the worst of the lot. All the state and territorial inspection authorities were skeptical of the value of any effort made in Chelsea; everybody having tried and failed. Field Engineer Percy Bugbee was assigned to the job in the fall of 1924.

He went into Chelsea for an investigation and found conditions even worse than he had anticipated. He made an earnest effort to arouse the city officials and the people to a consciousness of their fire peril, but without avail. Everywhere he went he met with the same indifference. Even the Chamber of Commerce, which at first had promised assistance, was unable to give it owing to the fact that it was fast losing influence in the city and was itself becoming an apathetic body. When the fire chief himself finally refused to see Mr. Bugbee when he called at headquarters all our ordinary resources for quickening the civic consciousness of

The complacency of its citizens and the apathy of its officials permitted Chelsea to lapse into a condition of which this scene is typical.

Chelsea seemed exhausted, and it was necessary to turn the spotlight upon her.

In the N.F.P.A. *News Letter* for May, 1925, appeared the following paragraph:

Chelsea, Mass.

General safety conditions are about as unsatisfactory as they could be. The Chamber of Commerce has little force; the fire chief is either without imagination or politically timid; the political morale of the city is low, and the conflagration conditions are little better than they were when Chelsea was last rebuilt at the expense of the rest of the country. The organization of a proposed Rotary or Kiwanis Club may serve as a rallying point for public intelligence. Meanwhile from the standpoint of fire safety Chelsea can offer no encouragement to home seekers nor business enterprises.

This was copied by the press of the country and the attention given it in the news and editorial columns of the Boston papers awakened the business interests of Chelsea and consequently her politicians.

The *Boston Traveler* asked "Does Chelsea Like Conflagrations?" and admonished the city to "wake up without waiting to be aroused by clanging fire bells." The *Boston Post* said in part: "The people who run things in Chelsea ought to realize what a discredit to their city such a reputation is—as well as the real danger—and compel reforms without delay." A third paper asked "Who Permits It?"

The mayor wrote letters of denial for publication; the Executive Office of the N.F.P.A. replied. These letters were made the subjects of additional Boston newspaper editorials not at all comforting to the pride

of Chelsea citizens. Other editors throughout the country copied them and commented on Chelsea's conflagration of 1908, and her apparent indifference to the debt she owed her sister cities.

There was one man in Chelsea who was not bound by the chains of politics, nor interested in making purely political replies to the indictment of the National Fire Protection Association. He foresaw in his city a repetition of that disaster of 1908 which stopped the wheels of industry and spread poverty and suffering everywhere. He decided that action was necessary and started gathering the facts with which he hoped to arouse his fellow citizens. This man was S. H. Robie, editor of the *Chelsea Evening Record*. With a newspaper man's imagination he was capable of visualizing the results that might follow the causes the field engineers of the National Fire Protection Association pointed out. Mr. Robie, handicapped by unfamiliarity with the procedure necessary to a fire prevention program, yet published on the front page of his paper facts which should have stirred his readers. He criticized them editorially, pleaded with them, even denounced them for their lack of public spirit. But his good work did not cause a ripple to appear on the calm surface of their complacency. Chelsea was sleeping the sleep of the deaf and the blind.

For some time, owing to the increasingly bad conditions in certain sections of the city, insurance companies had been quietly withdrawing. Mr. Robie discovered that some property owners found it almost impossible to get insurance. The whole community was affected by this intelligence; the merchants and manufacturers were filled with apprehension. In this period of alarm, the two men who had been separately doing their utmost for the city of Chelsea met.

A long conference ensued wherein Mr. Bugbee explained to Mr. Robie the difficulties he had experienced in his attempt to interest the proper officials in plans whereby Chelsea could regain the prestige she had lost. Some of his statements surprised Mr. Robie.

"Mr. Bugbee," said the editor, "let's go down into that high hazard district. I want you to point out to me the conditions you speak of. I want to know just why the insurance companies have refused risks in that locality."

Together they went into the "rag shop" district. "I've investigated fire hazards in various parts of the country," said Mr. Bugbee, as he pointed out the conditions about them, "but I can safely say that I've never seen an area where conflagration possibilities were so marked as they are right here."

Open spaces between buildings were piled high with scrap iron, rubber tires, rags, papers, boxes and other refuse imposing a serious exposure hazard on the adjoining buildings, and providing obstacles to the

fire department in the event of fire. Scattered throughout the district were unsightly buildings, housing people, which should long ago have been condemned as unsafe, and which now offered a very serious life hazard to the occupants. Old, dry wooden shingles served as roof coverings, a potential menace to the surrounding districts for some distance. Many of the streets were almost impassable, littered with all sorts of rubbish, a health menace as well as a fire peril. In several places where fires had occurred, no effort had been made to remove the debris which still contained enough combustible material to seriously expose adjoining property. The whole section was one unbroken fire area.

What was the reason for this disgraceful condition? Was it public indifference? Was it gross ignorance on the part of Chelsea's citizens? Mr. Robie, unable to answer these questions, decided to put them straight to the people of the city.

"Mr. Bugbee," said he, "I want you to put all this in writing. I want you to tell me just why the insurance people consider Chelsea such a poor risk. I want you to go into details in regard to the conditions we saw this afternoon. And I'm going to print the statement over your signature."

Mr. Bugbee's statement, which was printed in the June 29, 1925, issue of the *Chelsea Evening Record,* was a direct and unqualified arraignment of the officials of the city, and of its citizens generally. Mr. Robie backed up the statement by admonishing "indignant citizenry to protest, adequately and emphatically, against the shame, disgrace and slackness of our present fire hazard." He cried out to Public Opinion to exert itself on the city officials, compelling them to remedy conditions.

The result of this declaration of fact by a reputable fire protection engineer was a slight show of interest from Mr. Robie's readers. The following day he was able to print three letters from prominent local insurance men substantiating Mr. Bugbee's findings. There followed an account of clean-up orders which had been issued by Chief Hudson and completely ignored by those who received them. "Fire prevention," wrote Mr. Robie, "and the enforcement of orders connected therewith are the first need of the day in Chelsea."

On July 2nd, an arresting headline appeared: "Authority Lies Dormant While Fire Peril Grows!" The article was accompanied by pictures showing the deplorable conditions against which Mr. Bugbee and Mr. Robie were making their stand. On July 3rd, this appeared: "Chelsea Business Interests Demand End of Fire Hazard." Here was told the story of the head of one of Chelsea's industries who might be forced to take his business from the city. He was located in a sprinklered and metal-covered building, but he could get little or no insurance because that building was in the "danger zone." In the July 6th issue of his

paper, Mr. Robie wrote: "City Departments Are Not Fully Functioning in Rag Shop Area. How long are they to remain asleep at the switch?" The report that followed pointed out to the fire and police departments their duties, and demanded that they fulfill them.

Slowly the eyes of Chelsea opened and directed their gaze on the city officials. Immediately, the mayor became active, appointed a Fire Prevention Commission and made Mr. Robie chairman. "To me, as a layman," he then said, "there seems to be room for improvement, but hardly adequate grounds for so severe an indictment as was brought by Mr. Bugbee, or the refusal of insurance companies to place insurance in this district, or the practice of charging higher insurance rates in other sections of this city than customarily prevail in other cities." Mr. Robie at once raised the question whether "the responsibility, which the mayor so very graciously proposed to pass over to the commission, can be delegated by the board of aldermen. So far as formulating a plan is concerned the proposed commission may doubtless act without question, but beyond this it will take more than the opinion of a layman to decide how far it can go." Mr. Robie still held the officials to their responsibility. "Whatever may be done in this connection must be supplemented by the strong arm of official direction."

In consequence, on Monday night, July 13, 1925, a special meeting of the board of aldermen was called to consider the fire menace, and to hear witnesses responsible for statements of the extent of the fire hazard in the "rag shop" district. Requests to attend were sent to Field Engineer Bugbee, Editor Robie, John E. Beck of the *Gazette,* Thomas F. Punch of the *Catholic Citizen,* Secretary Francis X. Tyrrell of the Chamber of Commerce, Fire Chief David M. Hudson, Chief Charles M. Finn of the police department, James C. Denning, building inspector, John Caldwell, chief engineer of the New England Insurance Exchange. All members of the board of aldermen were present, as was Mayor Lawrence F. Quigley. The chamber was jammed with awakened, belligerent citizens.

It was natural that the man who first called Chelsea to account should be first called to account for his words. Mr. Bugbee said that he had little to add to his statement which was published in the *Evening Record.* He then told the board that he was acquainted with the contemplated plan to create an unpaid board or commission to investigate and right Chelsea's hazardous situation. "I do not think this plan practicable," he said. "This commission may investigate and report its findings, but it will have no specific authority to enforce improvements. The time has come, not only to specify a remedy, but to act for the correction of conditions. The obvious weaknesses here in Chelsea reside in the city building code and in inadequate legislation providing for complete inspections and en-

Public spiritlessness allowed this. It was common practice to use the streets for storage of junk, prior to the clean-up of Chelsea's rag district.

forcement of the inspectors' orders. But the very first step which should be taken is an immediate and thorough clean-up of the high hazard district in question."

When he had finished, he was bombarded with questions by the indignant assembly. He had first to explain away the implication that he was a representative of fire insurance companies. He was then asked to specifically mention some city he had visited where plans for fire prevention inspections were being successfully operated. He cited some. He

added that no other city in the country, to his knowledge, had a "rag district," nor was there one where such a storage section was allowed. He had never seen conditions anywhere so bad as in Chelsea.

At this point, Mayor Quigley took the floor. He asked Mr. Bugbee why these matters had not originally been brought to his attention instead of being handed to the paper for publication. "Had not the Mayor a common knowledge of these conditions?" inquired Mr. Bugbee. "I had no reason to assume the city officials' ignorance of the situation." Certain remarks which he made relative to the inactivity of the Chamber of Commerce, Mr. Bugbee was asked to retract. "I do not recall anything which I said that requires retraction," he replied; "certainly no action followed my recommendations to the Chamber of Commerce."

A day or so after this meeting, the mayor publicly characterized some of Mr. Bugbee's statements as false, and offered unconvincing figures to support his contention. He then leveled an attack at the N.F.P.A. Its membership, he stated, consisted of many concerns financially interested in fire prevention materials. "It is not necessarily to the discredit of these manufacturers that self interest prompts them to agitate for better fire protection. Mr. Bugbee, of course, renders a valuable service to his employers by agitating in favor of fire prevention apparatus and building materials, provided he does not overshoot his mark. . . . But falsehood and misrepresentation defeat their own purpose and constitute a rank injustice to the city attacked by such methods." When this broadside was published, Mr. Bugbee was working in Philadelphia on invitation of the Philadelphia Chamber of Commerce, which was launching a fire prevention movement. After all the publicity that had been given to the local situation it was patent to everybody that these remarks of the mayor were intended to discredit the N.F.P.A. rather than to elicit the truth about Chelsea. What the mayor did not realize was that conditions in Chelsea were of very positive concern to the rest of the country. He didn't get the point that Chelsea was in the public eye and that the city could no longer evade its responsibilities to the insurance premium payers of other cities who had already rebuilt it once. An indictment had been brought by the nation through the N.F.P.A. accusing Chelsea of once more being set to pick the pockets of the country by a conflagration. That was the point the country was looking for the mayor to answer. His statement was recognized at once by everybody as political and the reaction was distinctly favorable to the N.F.P.A. Newspapers took up the controversy and gave it the wider publicity it deserved.

Chelsea was under fire; the complacency of the city officials was being blown to pieces by the cannon of Public Opinion. Letters from citizens began to pour in to the office of the *Evening Record,* demanding

A typical condition in Chelsea.

action. Excerpts from two of them are typical. "Mr. Bugbee's letter is not one bit exaggerated or overdrawn. Much as I should like to deny it, I have to admit that it is only too true"; and "The articles, including Mr. Bugbee's excellent argument, proved interesting and instructive and no doubt have opened the eyes of the people of Chelsea, who care for something besides the almighty dollar, to the fact that this city has one of the worst fire hazards in this country. All the talk of responsible officials to the effect that the situation has been 'exaggerated' and similar bunk will not be swallowed by Chelseans 'in the know.'"

The mayor, it will be remembered, had shifted his responsibilities in the matter of Chelsea's fire conditions to the shoulders of a Fire Prevention Commission. He had given this commission authority to investigate and report. This is exactly what it did—very thoroughly. It held meetings, investigated, gave hearings to property owners, and then, in no uncertain terms, issued its report to the mayor. Following a summary of the situation, the report made these recommendations:

The commission, as a result of its inquiries, meetings and discussion, beg to submit the following recommendations:

INSPECTION—It is recommended that an inspection squad, composed of members of the fire department, detailed by the chief of the department, make regular inspections of buildings and conditions surrounding them, not only for the rag shop district, but wherever such inspections are needed throughout the city; that complete reports be made to the chief and permanent records be kept at fire head-

quarters; that every effort be made to secure obedience to the law governing fire hazardous conditions coming within the authority of the fire chief, as conferred upon him by the state fire marshal and by local ordinances; that in case of persistent and wilful neglect of any person to comply with instructions that such person be prosecuted according to law. It is recommended that details of firemen for this inspection work be in rotation under one head, namely, a deputy chief.

THIRD CLASS BUILDINGS—It is recommended that all third class buildings in the rag shop district, used for manufacturing, storage, sorting and baling of rags or other flammable or combustible material, be covered on the outside with metal of no less than 24 gauge thickness or with expanded metal lathe and stucco finish, and that fire resisting coverings be required on all renewed or repaired roofs as well as on new roofs. The code for new building construction is a part of the proposed city ordinances.

SPRINKLERS—It is recommended that all third class buildings used for the purposes as described in the preceding paragraph and having a ground area in excess of 2,000 square feet be equipped with automatic sprinklers.

SPRINKLER ORDINANCE—It is recommended that the present sprinkler ordinance be amended so as to read,—such buildings "shall be equipped throughout with a system of automatic sprinklers properly connected with an adequate water supply and shall have all sprinkler heads located, and spread, and spaced, and all pipe sizes made to conform to the standards recommended by the National Fire Protection Association."

BUILDING LAWS—It is recommended that the building laws be made positive, definite and applicable to all sections alike with the right of appeal from the building inspector's decision to a Board of Appeal, composed of three citizens with some knowledge of building construction, or to a Board of Survey, as provided by law.

SHEDS—It is recommended that no permit be granted for the erection of sheds, except for first or second class construction.

STORAGE—It is recommended that no material of any kind be placed or stored nearer than five feet to any building, so as to leave a clear space for easy access by firemen in case of fire.

OLD BUILDINGS—It is recommended that any building, if such exists, that is structually unfit and unsafe for occupancy be condemned and removed.

EXITS—It is recommended that an ordinance be adopted providing for at least two exits remote from each other from tenement houses and factories now existing or to be erected.

GARBAGE—It is recommended that the Board of Health require that garbage and ashes be placed in separate metal containers; that rubbish and garbage be not placed on the street until day of collections.

CARTAGE—It is recommended that all vehicles passing through the city, loaded with flammable materials, be covered with canvas or other equivalent covering.

POLICE—It is recommended that patrolmen be instructed to exercise vigilance in the matter of construction, permitting no work of building, alteration or addition without a permit therefor.

WILLIAMS ST. DUMP—It is recommended that the front of the Williams St. dump be enclosed by a wire or other like high fence to prevent paper from being blown into the streets and yards, and that entrance to the dump be locked when the watchman leaves at night.

Building sprinklered and metal covered, yard clean; this shows what pride and consciousness of fire peril can accomplish.

CLEANER STREETS—The commission is of the opinion that cleaner streets would be a great factor in the elimination of waste paper and its accumulation in back yards and against fences where boys with matches and cigar and cigarette stubs, thrown by careless smokers, are liable to start fires.

EDUCATIONAL—It is recommended that school children be given a regular course of instruction in fire prevention and that occasional public meetings be held with a view to urging the importance of adopting every practical measure for preventing fires.

In Conclusion

The commission, in submitting its report, is pleased to state that many property owners have already made marked improvement in their premises by covering wooden buildings with metal and in cleaning up in and around their buildings. It is

believed that by the adoption of the foregoing recommendations and their persistent application by those in authority, the reputation of the city will be greatly enhanced, the confidence of insurance companies will be restored, and protection be obtainable at much lower rates than at present.

Respectfully submitted,

S. H. Robie,
S. S. Eisenberg,
David M. Hudson,
James C. Denning,
Clarence Richmond.

Chelsea had taken the first step toward making herself fire-safe. The big question now was—"Will this report be acted upon?" The commission, with Mr. Robie as chairman, took care that it should. It issued copies of the report to all the insurance companies, receiving many favorable and gratifying acknowledgments, thereby placing Chelsea in a position from which she could not retreat. Virtually, the country awaited action.

Little by little, improvements began to be made. Old wooden buildings were torn down; other buildings were metal-covered; sprinklers were installed; the storage of waste material in open yards and streets was curtailed. Fire prevention inspectors were appointed, vested with authority, and are now functioning. And most important of all, a strong, concerted movement was launched for legislation designed to prevent Chelsea from lapsing again into the shameless condition in which Mr. Bugbee first found it.

The conflagration hazard is not yet entirely eliminated from Chelsea; there is still a considerable amount of inferior construction standing; and there are some few notable instances of failure to improve individual property. But the city is awakened to its fire peril, and that same pride which produced those civic achievements which have given so much satisfaction to Chelsea citizens, is now asserting itself in this new direction. Beside this it is generally known that the field engineering service of the N.F.P.A. does not act sporadically; it is a continuously functioning activity supported by the leading merchants and manufacturers of the country,—the big premium payers. Chelsea will continue to be regularly revisited and reported upon, and whatever she may do to reduce the ash heap of the country by attending to and lessening her many fire hazards, will be noted and commended.

The 1925 Fire Loss.

The total U. S. fire loss for 1925 was $570,255,000, according to the estimates of the Actuarial Bureau of the National Board of Fire Underwriters (Member N.F.P.A.) as presented in the current report of their Commitee on Statistics and Origin of Fires. The per capita fire loss for the entire country is set at $4.94. For 370 cities the average per capita loss is $3.53. A list of the cities in which the losses in 1925 exceeded $5.00 per capita follows. Similar figures for 1917-1921 appeared in the July, 1922, QUARTERLY (Vol. 16, No. 1, p. 16); for 1922 in the July, 1923 QUARTERLY (Vol. 17, No. 1, p. 26); and for 1924 in the July, 1925, QUARTERLY (Vol. 18, No. 1, p. 20).

Cities in Which Loss Exceeded $5.00 Per Capita.

†Council Bluffs, Iowa	29.67	†Hoboken, N. J.	7.36
Bay City, Mich.	26.58	†Gloucester, Mass.	7.30
East Liverpool, O.	22.31	*Williamsport, Pa.	7.07
*Bellingham, Wash.	18.54	‡Boston, Mass.	6.97
*Lancaster, Pa.	17.51	Steubenville, Ohio	6.71
‡Gloversville, N. Y.	17.30	*Nashua, N. H.	6.69
‡Shreveport, La.	15.77	East St. Louis, Ill.	6.55
*Huntington, W. Va.	14.35	†Lexington, Ky.	6.46
*Leominster, Mass.	14.09	†Nashville, Tenn.	6.41
†Peabody, Mass.	13.19	*White Plains, N. Y.	6.37
*Oswego, N. Y.	12.02	Austin, Tex.	6.27
†Ottumwa, Iowa	11.48	**Haverhill, Mass.	6.22
†Asheville, N. C.	11.33	Madison, Wis.	6.21
*Glens Falls, N. Y.	10.91	†Olean, N. Y.	6.18
†Vicksburg, Miss.	10.90	‡Springfield, Ill.	6.11
*Peoria, Ill.	10.82	†Portland, Me.	6.05
*Raleigh, N. C.	10.74	Gary, Ind.	5.96
Lockport, N. Y.	10.52	†Tampa, Fla.	5.93
†Fort Smith, Ark.	9.37	†Beverly, Mass.	5.87
*Shamokin, Pa.	9.35	†Buffalo, N. Y.	5.79
**Dallas, Texas	9.27	†Savannah, Ga.	5.79
*Hutchison, Kans.	9.24	Portsmouth, O.	5.79
Muncie, Ind.	9.19	*Norwalk, Conn.	5.79
**Kansas City, Mo.	8.95	*Duluth, Minn.	5.71
Salem, Mass.	8.91	Bloomington, Ill.	5.68
*Paducah, Ky.	8.89	*South Bend, Ind.	5.58
Newport, R. I.	8.81	**Charlotte, N. C.	5.51
Cedar Rapids, Iowa	8.12	*Little Rock, Ark.	5.48
*Everett, Mass.	8.01	Lackawanna, N. Y.	5.45
*Marion, Ohio	7.95	‡Memphis, Tenn.	5.44
Johnstown, Pa.	7.89	Scranton, Pa.	5.36
†New London, Conn.	7.85	*Danville, Ill.	5.35
*Dunkirk, N. Y.	7.62	*Lawrence, Mass.	5.26
*New Orleans, La.	7.59	Mobile, Ala.	5.22
‡Wilmington, N. C.	7.57	Newport, Ky.	5.07
Newark, N. J.	7.42	*Omaha, Neb.	5.01
‡Alton, Ill.	7.38	*Wheeling, W. Va.	5.00

*These cities in this class in two of the last five years.
†In this class three of the five years.
‡In this class four of the five years.
**In this class five years.

The following cities are those which come in for especial mention because they have had high burning records (over $5 per capita) for five successive years:

Dallas, Texas.	Haverhill, Mass.
Kansas City, Mo.	Charlotte, N. C.

Of these Kansas City, Dallas, and Haverhill have been in this class for six successive years.

Annual Fire Losses in the United States for Fifty-one Years—1875-1925 Inclusive.

Year	Aggregate Property Loss	Year	Aggregate Property Loss	Year	Aggregate Property Loss
1875	$78,102,285	1892	151,516,098	1909	188,705,150
1876	64,630,600	1893	167,544,370	1910	214,003,300
1877	68,265,800	1894	140,006,484	1911	217,004,575
1878	64,315,900	1895	142,110,233	1912	205,438,900
1879	77,703,700	1896	118,737,420	1913	203,763,550
1880	74,643,400	1897	116,354,575	1914	221,439,350
1881	81,280,900	1898	130,593,905	1915	172,033,200
1882	84,505,024	1899	153,597,830	1916	258,377,952
1883	100,149,228	1900	160,929,805	1917	289,535,050
1884	110,008,611	1901	165,817,810	1918	353,878,876
1885	102,818,796	1902	161,078,040	1919	320,540,399
1886	104,924,750	1903	145,302,155	1920	447,886,677
1887	120,283,055	1904	229,198,050	1921	495,406,012
1888	110,885,665	1905	165,221,650	1922	506,541,001
1889	123,046,833	1906	518,611,800	1923	535,372,782
1890	108,993,792	1907	215,084,709	1924	549,062,124
1891	143,764,967	1908	217,885,850	1925	570,255,921

NOTE:—Previous to 1916 figures obtained from the Records of the *Journal of Commerce*, deducting the Canadian losses. Subsequent years based on returns to Actuarial Bureau Committee, adding 25% for unreported and uninsured losses.

Comparative Fire Losses.

	Population	Total Loss	Per Capita
1921—Whole country	107,833,284	*495,406,012	4.59
370 cities	40,324,918	†141,406,007	3.51
1922—Whole country	109,248,393	*506,541,001	4.63
366 cities	33,821,476	†120,964,112	3.57
1923—Whole country	110,663,502	*535,372,782	4.84
372 cities	42,946,639	†147,102,119	3.42
1924—Whole country	112,078,611	*549,062,124	4.90
366 cities	43,375,796	†146,222,749	3.37
1925—Whole country	115,378,094	*570,255,921	4.94
370 cities	45,297,469	†160,011,951	3.53

*Estimated from Records of the Actuarial Bureau.
†Actual figures reported.

Canadian Fire Losses, 1925.

Fire losses in Canada during the year 1925 were lower than those of the preceding year, the total losses showing a progressive decrease in each of the past three years, the 1925 totals being 25% lower than those recorded in 1922, according to statistics compiled by Dominion Fire Commissioner J. Grove Smith. The following tables are taken from Commissioner Smith's report, presented to the Dominion Fire Prevention Association and the Association of Canadian Fire Marshals at their meeting in Ottawa in April. The first table is of particular interest in that it shows that the total cost of fire has been practically constant during the past four years, owing to the fact that while the fire losses have been decreasing, the savings have been balanced by the increase in the insurance premiums in excess of losses paid and by the somewhat increased expenditures for public and private fire protection.

What Fire Cost Canada in 1922-23-24-25.

	1922	1923	1924	1925
Value of Property Destroyed....	$54,390,688	$48,282,354	$45,906,531	$40,729,724
Insurance Premiums in Excess of Losses Paid	16,529,907	20,472,375	21,590,380	27,246,031
Maintenance Cost of Municipal Fire Protection	23,247,950	24,170,420	24,659,204	25,103,246
Installation and Maintenance Cost of Private Fire Protection.....	8,431,050	8,873,200	8,994,500	9,374,815
Total.....	$102,599,595	$101,798,349	$101,150,615	$102,453,816

A Decade of Fire Losses in Canada.

Year	Property Loss	Per Capita	Year	Property Loss	Per Capita
1916	$23,116,200	$3.00	1921	$45,015,900	$5.22
1917	26,298,400	3.32	1922	54,390,000	6.11
1918	33,870,000	4.12	1923	48,282,300	5.36
1919	25,216,300	3.00	1924	45,906,500	4.99
1920	28,081,200	3.27	1925	40,729,724	4.35
	Total.....	$370,906,524		$42.74	

Fires Classified by Extent of Loss, 1925.

Losses	Number of Fires	Property Loss
Exceeding $100,000	33	$8,653,900
$50,000 to $100,000	43	3,086,000
$25,000 to $50,000	91	2,730,200
$10,000 to $25,000	265	3,075,600
$5,000 to $10,000	818	5,726,400
$1,000 to $5,000	3,396	7,792,800
Below $1,000	27,111	9,664,800

Origin of Fires in Canada, 1925.

Causes reported	Number of Fires
1. Overheated stoves, furnaces and pipes	3,168
2. Sparks on roofs	2,896
3. Lightning	2,541
4. Defective chimneys and flues	1,975
5. Carelessness with matches	1,963
6. Electrical defects	1,845
7. Smoking	1,402
8. Coal-oil stoves	931
9. Reported suspicious	847
10. Portable lamps and lanterns	648
11. Hot ashes and coals	446
12. Illuminating gas devices	429
13. Spontaneous combustion	418
14. Open grate fires	293
15. Incendiary	162
16. Overheated steampipes	71
17. Miscellaneous known causes	3,006
18. Unknown causes	8,716
Total	31,757

Municipal Group Classification, 1925.

	Total Loss	Per Capita
Cities over 10,000 population	$13,463,301	$4.04
Towns 5,000 to 10,000 population	2,925,262	5.45
Towns 1,000 to 5,000 population	3,705,936	7.23
Villages under 1,000	5,717,524	4.62
Rural Districts	14,917,701	3.28

Occupancy Group Classification, 1925.

Group	Number of Fires	Property Loss
Manufacturing risks	1,573	$9,761,435
Mercantile Stores	3,684	8,114,036
Residential Properties	19,166	7,653,204
Farm Property (other than dwellings)	3,998	5,706,219
Institutional Buildings	487	1,426,598
Office Buildings	317	967,439
Miscellaneous Property	2,532	7,100,793

Children Die in Film Fire.

Louis Lelong, Jr., 15, and his 4-year-old sister Mary were fatally burned just before noon on May 1, 1926, in the basement of 225 Grove Street, South Orange, N. J., when a flare-up occurred in the motion picture machine the boy was operating for the amusement of a gathering of his young friends. When the fire in the film was discovered, Louis safely piloted the seven or eight youthful spectators from the "theatre," and then returned in search of his sister. When he reached her unconscious figure he was overcome by fumes from the burning film. The two children were taken to the Memorial Hospital where little Mary died about 3 o'clock, followed by her brother about two hours later.

Cause of the Fire.

The machine involved in this tragedy bore the name "Optica" and was stamped "Made in Germany." A newspaper called attention to the fact that the machine "had been passed by the fire underwriters"; but upon investigation, it was found that no motion picture machine carrying that name had ever been submitted to Underwriters' Laboratories for examination and test. It was first thought that a short-circuit was responsible for the flare-up, but from the stories of those present, it was decided that direct exposure of the film to an electric lamp caused the reel to catch fire. Obviously, the film was of nitro-cellulose stock, although the several rolls in use were entirely destroyed.

Story of the Fire.

It was the habit each Saturday morning for the Lelong children to give their friends a "moving picture show" in the basement of the Lelong home. On the door at the laundry room appeared this sign: "Realm Theatre—Latest Reels Every Saturday at 10 A. M."

During the "show" on the morning of May 1st, the film had slipped, or left the reel guard. Louis, who was operating the machine, stopped it to make adjustments, but neglected to shut off the arc light or lamp. The light focused on the exposed film in the reel, generating enough heat to cause it to break into flame. The boy, lifting the shutter on the side of the reel, noticed a little flame and told his "audience" that they had better leave, as there was a small fire which he would have to put out before the "show" could continue. It is thought that he then attempted to blow out the flames. This action caused the flare-up which at once spread the fire

to several other reels lying on the table close by, and thence to paper decorations and fabric bedroom screens which served as a booth.

Louis directed his friends through the smoke to safety assuring them that it "was not much of a fire." When all were outside, he noticed that Mary was not among them, and rushed back to save his little sister. But just as he reached her unconscious figure, he was overcome by fumes. When later found by firemen, his body was bent over that of Mary in an attitude of protection. The girl never regained consciousness, but the boy lived long enough to tell the story of the attempted rescue, and to "hope that little Mary was all right."

A motorcycle policeman and detective were the first to arrive at the scene of the fire. They forced in the door, but were driven back by the fumes from the burning film, and later required medical attention. It was necessary for the firemen to don gas masks before they could penetrate the smoke to reach the dying children. The damage to the building was very slight, as the fire was confined principally to fixtures and decorations.

Conclusion.

The prevention of the recurrence of such a tragedy as this lies in the absolute prohibition of the sale of moving picture films of nitro-cellulose stock except where they are to be used in a standard fire-resistive booth and handled by a licensed operator.

The Fireboat Port Houston.

The *Port Houston,* new Diesel-electric fireboat built for the port of Houston, Texas, is the first fireboat of this type, and represents the last word in fire-fighting vessels. The *Port Houston* was demonstrated at Atlantic City in May at the annual meeting of the N.F.P.A., the demonstration being the outstanding feature of the special marine program under the auspices of the N.F.P.A. Marine Committee, S. D. McComb, chairman. At this time the vessel was thrown open for inspection and later was put through a variety of maneuvers and pumping demonstrations intended to show that the Diesel-electric system responds better to all the requirements than any steam or gasoline installation.

The *Port Houston* is 125 ft. 10 in. long overall, 27 ft. 0 in. beam and with a draft of 8 ft. 6 in. Her power equipment consists of two main and one auxiliary generating units. The main sets are composed each of one 500 hp. 6-cylinder Diesel engine turning at 420 r.p.m. and direct connected with a 350 kw., 500 volt generator and a 25 kw., 125 volt exciter. The auxiliary set consists of a 165 hp. 6-cylinder Diesel engine turning at 425 r.p.m. and direct connected with a double generator having a total capacity of 100 kw. at 270 volts and belted to its 10 kw. 125 volt exciter at the higher speed of 720 r.p.m.

These three sets constitute a power plant which serves the double purpose of providing electric power for propulsion and electric power for pumping. To all intents and purposes the *Port Houston* is an electric fireboat with electric power furnished by a Diesel-driven generating plant. For propulsion two electric motors of 260 hp. each are used, turning at a maximum of 265 r.p.m. For pumping, two 410 hp. electric motors are used, direct connected with centrifugal pumps and delivering their rated capacity at 175 r.p.m. The main propulsion motors as well as the main pump motors operate on the 500 volt circuit. The power available from the main generators is not sufficient to take care of all these motors at any one time.

The underlying idea of the installation is that maximum power will be available for propulsion when the boat is hurrying to a fire and that full power will be available for the pumps when the fireboat arrives at the scene of operations. This still leaves the maneuvering of the boat at

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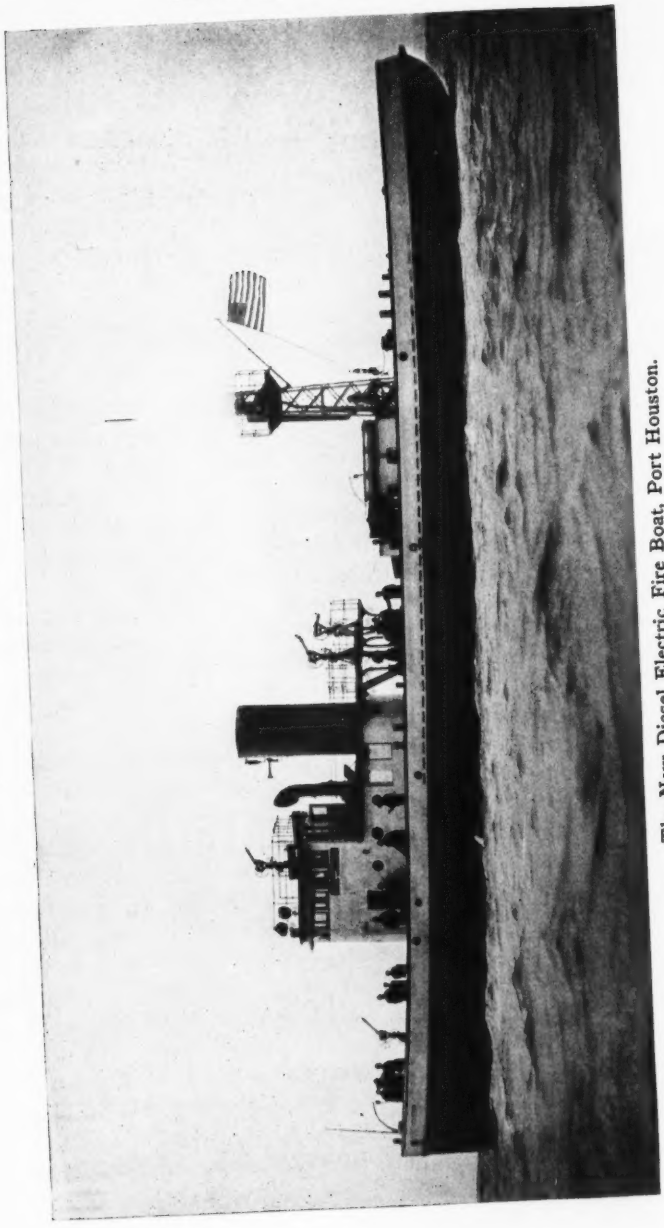
The data and illustrations used in this article are taken from the June issue of *Motorship,* by courtesy of the editor.



The New Diesel Electric Fire Boat, Port Houston.

The Port Houston During the Demonstration Before the N.F.P.A. Convention at Atlantic City.

the fire to be taken care of, and it is for this purpose that the auxiliary generating set has been installed, namely, it provides a total of 100 kw. which can be split up between the twin propelling motors to operate them at reduced power and speed when the power from the main generating sets is being completely utilized in the pumps. The three Diesel engines are all of Winton make; the electric equipment has been supplied by the Westinghouse firm and the big pumps are of Worthington manufacture.

These two big pumps can supply 3,500 g.p.m. at a pressure of 300 lb. per sq. in. or a maximum of 7,000 g.p.m. at 150 lb. per sq. in. Altogether there are 39 nozzles distributed around the boat, and when water is being pumped through all of them simultaneously it represents something like a cloudburst. All these nozzles can be brought to bear in any direction or they can play their streams in different directions.

All the fire commissioners at Atlantic City were greatly impressed by the demonstration of the *Port Houston* and by the realization that she incorporates greater efficiency as a fire-fighting unit than any piece of floating fire equipment that has yet been built in the world. Not only does she perform all that could be accomplished with a steam fireboat or with a steam-electric fireboat, but she achieves it also at a greatly reduced cost, notwithstanding the slightly increased capital investment which she represents. There are, of course, no standby losses in her and yet she is instantly available to respond to any fire call and can get under way as fast as the crew can get to its stations.

The Port Houston in Action Off Atlantic City.

In point of maneuverability she represents, of course, the practical zenith. Nobody can deny that in this respect electricity is much handier than either steam or the straight drive of internal-combustion engine. Intrinsically her own fire hazard is a minimum, because she uses for fuel not a highly flammable liquid like gasoline or a moderately flammable fluid like kerosene, but a grade of fuel oil generally regarded as having a very small fire risk. It does seem a little strange, however, that a ship of this character, which will be called upon to fight fires in fairly restricted areas in a big oil shipping port where burning oil may escape from shore tanks and form an extra hazard on the water, is not herself protected against fire.

The Harris County Houston Ship Canal Navigation District Commission are the owners of the ship, which was designed by Cox & Stevens of New York and built by the Bethlehem Shipbuilding Corp. at the Harlan yard at Wilmington, Del.

The Holland Vehicular Tunnel.

Fire Protection and Safety to Life.

By W. F. Steffens.
(Member N.F.P.A.)

Considerable publicity has been given recently to the fact that construction work is well advanced at the new Holland Vehicular Tunnel under the Hudson River, connecting the States of New York and New Jersey, but little has been written regarding two features in which the public will naturally be vitally interested. While numbers of long tunnels, some beneath important waterways, have been successfully constructed and operated, these have been in practically all cases for railway traffic, usually electrically operated. In this respect the Holland Tunnel differs in that the twin tubes will enable the passage exclusively of vehicles, probably all gasoline-propelled, and pedestrians. Hence, the necessity for the prompt removal of gases exhausted from the engines of these vehicles, and the supply of great volumes of fresh air, can be immediately realized. These operating conditions classify this structure as unique in an engineering sense. An equally important detail affecting the safety of the public is the care taken in the design to provide control of any fires that may occur.

The importance of a great engineering work like the Holland Tunnel will be apparent when it is realized that Manhattan Island, on which is located one of the Boroughs of New York City, is entirely cut off from vehicular communication with the adjacent state of New Jersey by the Hudson River, except by ferry transfer. In recent years tunnels exclusively for railway passenger traffic have been built. Fogs and ice floes on the river have embarrassed ferry transfer between the two shores and emphasized the necessity for a reliable means of expediting traffic. While bridges across the East River have been used to afford communication between the Island and the Borough of Brooklyn, the great length of span necessary for a bridge over the Hudson River, together with the long and costly

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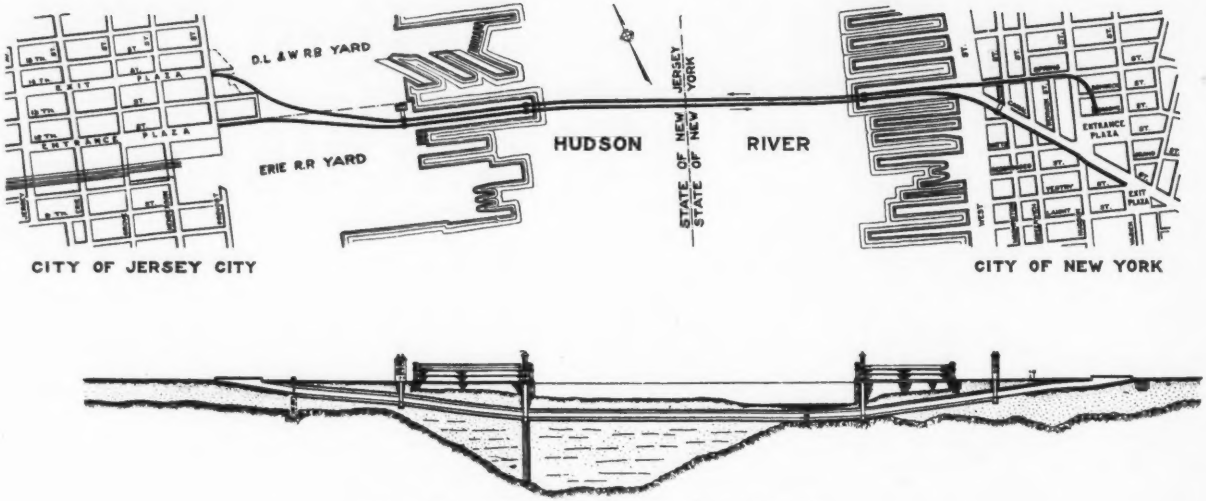
Editor's Note: The New York City Committee, N.F.P.A., in the course of its activities looking towards the control of fire hazards in Greater New York has given careful attention to the Holland Vehicular Tunnel, and this article was prepared at their suggestion. Through the efforts of the Committee the subject matter of this article is to be given wide publicity, for the purpose of informing the public that the potential fire hazards of a tunnel of this character have been properly safeguarded in the design of the Holland Vehicular Tunnel.



The Holland Vehicular Tunnel: Plan and Profile.

Tunnel Lengths.

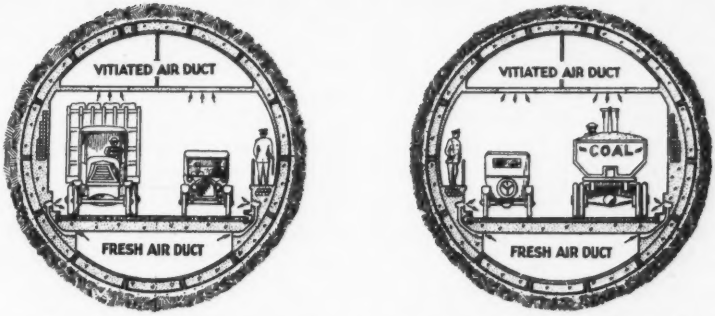
Total length of Tunnel	9,250 ft.
Distance between Portals	8,463 ft.
Distance between River Shafts	3,374 ft.
Length of Under-River Portion	5,480 ft.
Maximum down-grade	4.06%
Maximum up-grade	3.8%

Capacity.

Number of Roadways	2
Roadway widths	20 ft.
Headroom	13 ft. 6 in.
Estimated hourly capacity (in both directions)	3,800 vehicles
Estimated maximum daily capacity	46,000 vehicles
Estimated yearly capacity	15,000,000 vehicles

Construction Data.

Maximum depth to top of tunnel below M.H.W.	72 ft.
Maximum depth of roadway below M.H.W.	93 ft.
Quantities:—	
Excavation	500,000 cu. yd.
Cast-Iron Tunnel Lining	115,000 tons
Concrete	130,000 cu. yd.



The Holland Vehicular Tunnel. Cross section of the two tubes showing provision for ventilation. The external diameter of the tunnels is 29 ft. 6 in.

Air will be discharged from the bottom duct and removed through the upper duct continuously throughout the length of the tunnel, with no longitudinal movement of air. The ventilation provides for changing the air 42 times per hour, with a total supply of fresh air to the tunnel of 3,761 cu. ft. per minute. The carbon monoxide content of the air in the tunnel is to be limited to 4 parts in 10,000.

approaches, have for years prevented favorable consideration of bridges. On the other hand, the construction of a tunnel involved other engineering problems, including the matter of ventilating a structure nearly one and three-quarters miles in length, through which would pass a daily traffic estimated at 46,000 vehicles, or a maximum of fifteen millions per year. As far as the physical construction of the tunnel itself was concerned, precedent had been established in the under-river tubes of the Hudson and Manhattan Railway and of the Pennsylvania Railroad. Even though long railroad tunnels have been equipped with ventilating devices, principally by induced draught through huge nozzles, no precedent existed for the huge ventilating facilities necessary in a vehicular tunnel where gases must be removed practically as fast as formed, instead of being forced to travel to one of the entrances, or to a shaft. The extent of the problem, however, in this case was such that before designs could be prepared, research work was necessary to develop some of the controlling features, first of which was the amount and composition of the gases from the large number of automobiles that would pass through the tunnel in a given period of time, and the physiological effect of these gases on the human system. With these facts established to determine the volume of fresh air supply necessary, further experimental work was conducted to determine friction incident to movement of the air through the various ducts and passages, and the power to give the desired result. Finally, a typical section of tunnel was constructed in a mine in Pennsylvania in

which numbers of automobile engines were operated for days simultaneously with the experimental ventilating plant. As a result of all this research the judgment of the engineers was confirmed and the final ventilating plant was designed accordingly.

The Holland Tunnel consists of two single tunnels or tubes of rectangular section in the solid ground of the approaches, but with circular section under the river. The latter section is of the familiar type of construction with cast iron and steel segments firmly bolted together, and surrounded with concrete. The exterior diameter of each tube is 29 ft. 6 in. A flat ceiling hung from the upper part of the structure, and a roadway supported by structural steel work resting on the ring, provide two spaces between the circular ring and these flat surfaces which are utilized in the ventilating system, the lower space as the fresh air supply, and the upper space for exhaust of vitiated air. The clear height between the roadway and ceiling is 13 ft. 6 in. At one side of each tube the space between the circular ring and a vertical wall adjacent to the roadway is utilized for ducts in which low-tension communication wires can be placed, and a six-inch water main, and also for niches to shelter water connections, sand boxes, fire extinguishers, telephones and fire alarm stations. At the other side a narrow, elevated sidewalk includes additional ducts for high-tension wires. The roadway is 20 ft. wide between curbs. Adjacent to each curb extends a continuous slot just above the roadway level through which fresh air is distributed from the ventilation openings ten to fifteen feet apart, communicating with the main duct beneath the roadway. In the ceiling, closely spaced transverse openings protected with bronze gratings permit vitiated air to be drawn into the exhaust duct. By the difference in pressure between the air supply and that at the exhaust openings, positive removal of vitiated air will be assured. Air movement will be provided by eighty-four ventilating fans located at four ventilating shafts, two of these near the river pierhead lines and two at the shore ends. These will deliver nearly four million cubic feet of fresh air per minute, or a positive renewal every ninety seconds. The structures sheltering the ventilating plant are in themselves interesting features. They will extend to a maximum height of five stories above grade, and provide for discharge of the vitiated air and gases at a height sufficiently great to afford necessary dilution.

It will be evident that the ventilating system is practically the "lungs" of the tunnel system, failure of which must be positively prevented. Power for operating the system, therefore, is from four independent generating stations, two at each end of the tunnel, with three cables from each, or six cables in all, but interconnected so as to positively assure

continuity of service. Of the six cables, moreover, any single cable is capable of carrying the entire load. This feature alone is an indication of the care taken in all of the design of the structure to anticipate every possible emergency that can arise to interfere with the continuous operation of this important traffic artery.

In order to control promptly any fire that may occur in an automobile, portable five-gallon extinguishers of the foam type will be available in niches spaced approximately 120 feet apart. At the sidewalk these will be alternately one and two per niche, with one and five alternately at the opposite curb. Thus in a maximum distance of 120 feet from any single point at least eleven extinguishers will be available, and others can also be brought forward. The patrolmen assigned to duty in the tubes will be thoroughly familiar with the location and method of operation of these extinguishers. At intervals also of 120 feet there are hose connections for flushing the pavement, but at these points an additional outlet will be furnished with a permanent installation of 2½ in. fire hose, by means of which even a fire of considerable size can be controlled. Smaller niches located 240 feet apart will shelter sand primarily for use on the roadway, but it will also be available as an extinguishing agent for gasoline fires. While the spacing of all of these facilities, as outlined, is for the circular section, the spacing on the approaches or rectangular sections will be nearly as frequent. In addition to the fixed fire protection facilities described, automobile wrecking cranes located at the land ends will be available to assist crippled vehicles so as to prevent delay to traffic. Each of these cranes will also be provided with large foam generators to furnish quantities of foam, should the smaller extinguishers prove insufficient.

Traffic through the tubes will be directed by patrolmen stationed at short intervals, and further supervision will be given by traffic light signals 240 feet apart which will simplify clearing the tunnel in case of fire or accident. Westbound traffic in two streams will pass through the north tube while eastbound movement will be through the south tube, the right hand stream in each case being reserved for slow-moving vehicles.

Work has progressed to such an extent that the finish of white glazed tile is now being placed on the walls, and it is possible to walk from end to end of the tunnels. The structures contemplated for housing the ventilating shafts at the pierhead lines have not yet been completed, and considerable work yet remains on the street approaches, to create the necessary broad plazas through which traffic can be distributed conveniently to adjacent streets. This work illustrates a practical solution of one of the largest ventilating and fire protection problems ever presented to the engineering profession. It is estimated that the cost of the work ready

for operation will not exceed fifty million dollars.

The writer is indebted to Mr. Ole Singstad, chief engineer, member of the American Society of Civil Engineers, for the information from which this article was prepared and by whose courtesy a trip through the tunnel was permitted.

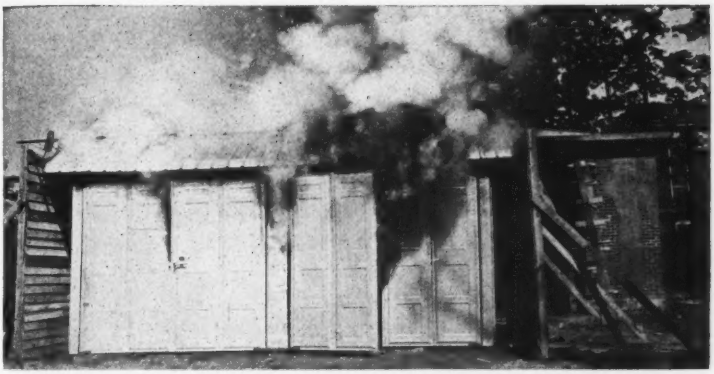
Fire Tests of Sheet Steel Garages.

Two tests to determine the stability under fire conditions of all-steel garages and the hazard to adjacent buildings incident to a complete burning out of contents have been recently completed at the Bureau of Standards. Municipal building code and fire regulations vary widely in different cities relative to the minimum distance from the lot line and adjacent buildings at which such garages can be built. Where space is limited this often determines the choice in type of garage construction used. The tests were conducted at the request of the Sheet Steel Trade Extension Committee (Member N.F.P.A.) which constructed the garages for the tests.

The garage burned out was 18 by 18 feet in horizontal dimensions with gable roof and built to accommodate two cars. The sheet metal roof was supported by the steel end framing and one center steel truss. The contents for each test consisted in part of two old 5 or 7 passenger automobiles near the medium in weight and size, having wood framed bodies, one touring and one sedan. A 10-foot work bench, shelves, paper, waste barrel and lumber on the floor and on the steel framing overhead gave an additional combustible content of about 1000 pounds. There was about 14 gallons of gasoline in the tanks of the two cars and the crank cases were filled before the test. From information available the combustible contents were somewhat above the average that ordinarily obtains.

In the first test, three wood frame walls finished with old lap siding, were placed adjacent to three sides of the garage, 12 inches, 18 inches and 24 inches, respectively, from the wall lines. Temperatures were measured inside of the garage and on the exposed surfaces of the wood walls. The weather was warm (86° F.) at the time of the test and calm. The fire was started in the front of one car and within 15 minutes both cars were burning actively. The average temperature within the garage rose to a maximum of 1060° F. in 70 minutes, after which it fell slowly, being 637° F. at 2 hours, 426° F. at 3 hours, and 264° F. at 4 hours. The

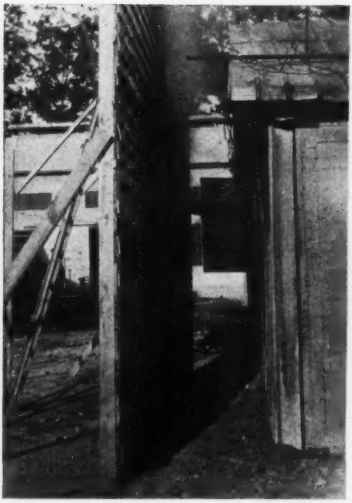
Note: This article is taken from the Technical News Bulletin of the U. S. Bureau of Standards.



First test of sheet steel 2-car garage. Two old automobiles with over 7 gallons gas in each and nearly 1000 lbs. of lumber and combustible material were placed in the garage and ignited. This picture shows the first blaze through the door which was blocked ajar 16 in. to facilitate rapid combustion. The wooden walls, spaced 12 in. and 18 in. away from the metal garage wall, ignited repeatedly by radiated heat, but were kept from burning by the streams from hand extinguishers.

maximum temperature measured inside of the garage at any one point was 1339° F. One of the double doors of the garage was kept partly open during the test to admit enough air for free combustion. Everything combustible within was completely consumed, even the oil in the crank cases. Glass and the more fusible metals were melted. The gasoline in the tanks vaporized and burned quietly without any explosive effects. The garage walls and roof did not buckle or open up appreciably during the fire. It effectively restrained the flames and hot gases within, the heat exposure to the wooden walls being almost wholly from radiation. These ignited in from 30 minutes to one hour after the start of the test, depending on the distance from the garage walls. The fire on each could be kept down within a 5 gallon pump type fire extinguisher that was refilled with water at intervals.

In the second test two wooden walls were spaced, respectively, 3 feet and 5 feet from two of the garage walls, and near the third wall was placed a sheet metal garage with part of the exposed wall two feet, and part of it three feet from the wall of the garage to be burned out. The exposed metal garage had a wood bench against its exposed wall with oily waste on it in contact with the metal of the wall. It housed a car with gasoline in its tank and carburetor. The fire inside of the garage attained about the same intensity and duration as in the first test. The wooden wall spaced 3 feet from the garage ignited one hour four minutes after the start of the test and small blazes on this wall developed at

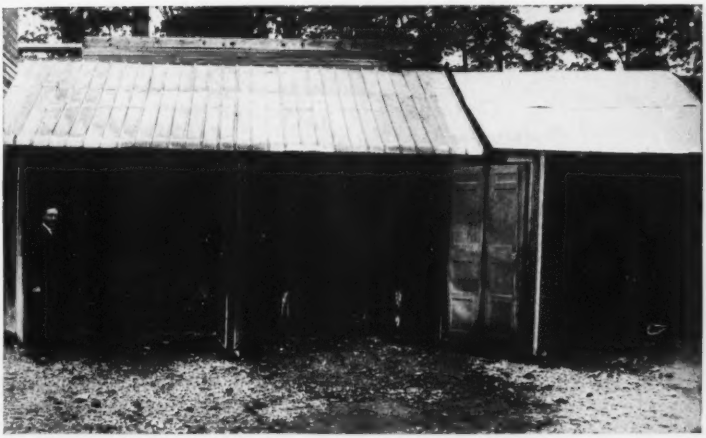


Wooden wall 3 ft. away from sheet steel garage in second fire test. Photograph at the left shows wall smoking under radiated heat. Photograph at the right shows places where wood ignited. This was old yellow pine siding. Ignition occurred only at old nail holes.

intervals during the next 30 minutes. They were all easily quenched with the hand pump extinguisher. The wall spaced five feet from the garage did not ignite but a high enough temperature developed to cause smoking of the boards about five feet above the ground. The maximum temperatures indicated by thermo-couples against the exposed face of this wall was 360° F., although it is probable that portions of the wall were somewhat hotter. After exposures to heat of durations comparable with those obtaining in these tests, wood ignites at temperatures near 482° F.

The measured temperatures inside of the exposed sheet metal garage did not exceed 163° F. as measured against the inside face of the sheet metal wall placed 2 feet from the burning garage. The temperature inside of the car in this garage did not exceed 82° F., the outside air temperature during test being 70° F. The temperature of the gasoline in the tank of this car rose only 3° F. and the temperature near the carburetor 5° F.

The interpretation of results depends on the assumptions relative to the degree of hazard with which a minor building such as a garage may expose a major building or another garage. If exposure of a degree that can be controlled with minor fire fighting equipment or effort is to be permitted, it is apparent that the all steel garage can be placed as close as



After the second test: The wreckage of the two automobiles in the two car garage indicates the intensity of the fire which burned for three hours reaching a temperature of 1350° F. The other metal garage at the right, separated by a space of 2 ft., was not affected, the oil soaked rags hanging against its wall not even smoking.

one foot from the lot line for all walls except the door side, provided any windows in the wall next to the lot line or exposed building have fixed metal frames glazed with wired glass. Under the same conditions an all steel garage would be no hazard to a similar garage two feet away.

The fact that there was little buckling or other distortion of the sheet steel and framing members can be attributed to the low loads present during test. These buildings must necessarily be designed for wind and snow loads that give stresses several times higher than those from the dead load of the building itself.

These tests as well as some preliminary trials with the burning of gasoline in automobile gasoline tanks indicate that there is little probability of explosions occurring. If pressure develops due to vaporization of the gasoline it is likely to be relieved before a high intensity is built up by failure of the joints of the tank, failure of carburetor or vacuum tank or melting of soldered connections.

Tests on Combustibility of Roofing Materials.

Conducted by Committee of Dominion Fire Prevention Association.

At the meeting of the Dominion Fire Prevention Association in Ottawa, April 29, 1926, a comprehensive report was presented by the Committee on Combustibility of Roofing Materials covering its activities since its appointment following the adopton of a resolution to investigate roofing materials at the meeting of the Dominion Fire Prevention Association in September 1921. The committee personnel is as follows:

Committee

H. M. MacKay, M.E.I.C., M.Am., Soc. C.E., Chairman
R. DeL. French, M.E.I.C., M.Am., Soc. C. E.
F. M. G. Johnson, Ph.D., F.I.C., F.R.S.C.

Engineer in Charge

H. E. McLellan, B.Sc., A.M.E.I.C.

The original report, "Printed by Authority of the Minister of Finance" of the Canadian government, is voluminous, and as the edition is exhausted, is not available for distribution. The report is reprinted in the following pages, omitting tables of properties of individual makes of roofing, diagrams, photographs of laboratory apparatus and other technical detail. One table, Table V, has been reproduced in skeleton form, with summaries of the types of roofings tested, the lists of trade names and manufacturers appearing in the original report being omitted.

The Report.

It is unnecessary to go into the factors which influenced the Committee to decide to carry out all its investigations and experimental work in a laboratory of its own in Canada, other than to say that among them was the expressed desire of the roofing industry that this procedure be followed. The Committee's experience in operating its own laboratory has convinced it that the decision was a wise one. In fact, it is doubtful if any other method of carrying on the Committee's work would have been at all practicable.

The equipment of the laboratory and the methods of conducting the routine tests of roofing materials have been described in previous reports, but it will perhaps be well to cover the ground again briefly in this report.

All roofing materials are laid on 3 x 3 ft. "decks," made of ⅞ in. tongue-and-groove boards, laid tight on 2 x 3 in. cleats. All lumber is

kiln-dried to approximately constant weight before use, to avoid variation in test results due to varying moisture content in the deck material. The face of each deck is scored with 7 shallow saw cuts in each direction.

All roofing materials are laid strictly as specified by the makers: in some cases, the maker has laid his own material on our decks under our inspection. Before covering a deck, No. 20 white cotton threads are placed in the saw cuts referred to above, care being taken that they are quite free to move easily longitudinally.

Two types of fire tests are applied to all materials, viz.:—

1. Flame Test.

The flame used is produced by a special city gas burner (modified "hotel range" type) adjusted to lie 1 in. from the surface of the deck, which is supported on a suitable stand. A constant pressure of 5 in. of water is maintained on the gas supply: under these conditions the consumption of gas is about 135 cu. ft. per hour. The elapsed time from the beginning of the test to the breaking of each thread, previously weighted, is recorded, also the elapsed time to the appearance of flame on the under side of the deck boards. If no flame appears in one hour, the test is terminated. At the conclusion of a test, the general condition and the area of the burned portion of the roofing sample is noted, the deck photographed front and back and the roofing removed from it, and the maximum depth of the charred surface area on the deck boards under the roofing is measured.

2. Brand Test.

Four styles of brand are used, designated "A," "A-1," "B," and "C." All are made of kiln-dried lumber; the details follow:—

Brand	Number of Sticks		Dimension of Sticks	Ignition Time
	Maple	Basswood		
A	.....	10	⅜"x⅜"x3½"	45 sec.
A–1	3	7	$\frac{9}{16}$"x$\frac{9}{16}$"x5⅝"	60 "
B	5	5	¾"x¾"x7¾"	90 "
C	10	.....	1⅛"x1⅛"x12"	120 "

Decks are set up for the brand test in a manner similar to that used for the flame test. Brands are ignited in a special gas fired brand furnace, and transferred to the deck under test when flaming. They are not disturbed during the test; they either burn out without producing permanent ignition of the roofing, or they set the roofing afire, and ultimately the deck burns through. When either event takes place the test is terminated. In testing roofing, a start is made with Brand "A." If this does not produce failure, the heavier brands are applied successively until one is found which does produce it, or until all have been tried and no failure

results. The data collected is the same as in the flame test.

In both tests, decks are subjected to a "wind" of 12 m.p.h., produced by a suitable fan. Arrangements are provided so that the wind may be raised to standard temperature in cold weather.

Late in 1925, a rather critical study of the results of the fire tests made up to that time convinced the Committee that a fair ranking of roofings as regards fire resistance was an exceedingly difficult task. One member of the Committee, accompanied by the Committee's engineer, therefore, paid a visit to the Mellon Institute, of Pittsburgh, Pa., and inspected the work being carried on there under the direction of Mr. E. S. Ross, Roofing Fellow. Mr. Ross gave the Committee every possible assistance, and made many valuable suggestions. Following this conference, it was decided to conduct an investigation to a limited extent into the physical and chemical properties of the roofings tested. This work was put in hand at once, but so far our laboratory force has not been able to do more than to make a beginning, as much of its time is required for routine fire testing of new samples, which are constantly being received. The unit weights of all roll roofings and prepared shingles have, however, been determined. In addition, we expect to collect data on:—

(*a*) Tensile strength.
(*b*) Punching strength (Mullen test).
(*c*) Weight and characteristics of saturant.
(*d*) Weight and characteristics of coating.
(*e*) Weight and characteristics of felt base.

These data we hope may enable us to explain the somewhat erratic behavior of many roofing materials under fire test, and perhaps allow us to reduce all samples to some sort of "lowest common denominator" so that they may be accurately and fairly ranked, a matter of the utmost difficulty with the information available at this writing. There is little doubt but that the first of our hopes will be realized; of the second we are much less sanguine.

To date 118 samples of roofing materials have been tested. These samples may be classified according to the materials used in their manufacture as follows:—

Wooden Shingles
Asphalt-Saturated Rag-Felt Roll Roofing.
Asphalt-Saturated Rag-Felt Shingles.
Asphalt-Impregnated Asbestos-Felt Roll and Sheet Roofing.
Asphalt-Impregnated Asbestos-Felt Shingles.
Sheet Metal.
Asbestos Cement Shingles.
Slate Roofing.
Asphalt Asbestos Built-Up Roofing.
Pitch-and-Gravel Built-Up Roofing.

Wooden Shingles.

The wooden shingles tested were of both red and white cedar. The red cedar shingles were of the first grade and of three sizes known according to the Shingle Manufacturer's Association of British Columbia as "British Columbia 24 in. Royals 4/2 in.," "18 in. Perfections 5/2½ in.," and "16 in. XXXXX 5/2 in." The white cedar shingles were graded as "Extras," " Clears," "2nd Clears," "Clear Walls" and "Extras No. 1."

The greater part of these shingles was tested while in a moderately dry condition. Two decks of each sample were dried in the laboratory kiln, for a period of 72 hours, at a temperature of 55° C. before testing. The moisture content, based on kiln-dry weight, for shingles dried in the kiln varied from 4 per cent to 8 per cent, while in those not dried it varied from 8 per cent to a maximum of 36 per cent.

Both red and white cedar shingles took fire readily under the action of brand "A." The surface of the shingles immediately under the brand took fire almost at once and burnt with flame until the brand was consumed. The flame then generally went out leaving the shingles glowing with red coals. Under the action of the wind, the fire then worked its way into the shingles and the deck boards, broke out into flame again and the roof deck failed by the flame appearing on the under side. In the case of the white cedar shingles, practically every brand applied caused the deck to fail in this manner, but in the case of red cedar shingles in about 50 per cent of the brands applied, the fire went out of its own accord without doing serious damage to the shingles. A marked difference was noticed in the spread of fire in red cedar and in white cedar shingles, the spread being greater in the latter.

In the flame test both kinds of shingles failed by flame appearing on the under side of the deck in about 25 or 30 minutes. Both produced numerous small burning particles, the white cedar shingle being the worse offender in this respect.

Asphalt-Saturated Rag Felt Roll Roofing.

In all 57 samples of asphalt-saturated rag felt roll roofing were submitted for testing. This material varies in weight, according to the weight of felt, amount of saturant and surfacing materials used, from 32.5 to 102 lbs. per 100 square feet of roof surface. The more common weights are 35, 45, and 55 lbs. per square, designated as light, medium and heavy respectively. These are also known to the trade as 1, 2 and 3 ply. The light, medium and heavy weights are usually surfaced with talc, soapstone, mica or sand. Weights heavier than these usually have rock or slate granules imbedded in the surface coating.

This type of roofing showed an increase in fire resistance over wooden shingles, but not to such an extent as might perhaps be expected.

Out of 57 samples tested, 18 failed under the action of the smallest brand (Brand "A"). The remainder successfully resisted the action of this brand, but the deck boards were usually charred more or less. That brand "A" approaches the limit of fire resistance of this type of roofing, was shown by the complete failure resulting when tested with the next larger brand (Brand "A-1").

In the flame test, as well as in the brand tests, small burning particles were detached from the roofing. Occasionally these particles were in a flaming condition, but generally were merely glowing with red coals and would go out almost immediately after leaving the deck.

All makes of this type of roofing, with the exception of that surfaced with slate or rock granules, showed a tendency to communicate fire by the burning of the top surface coating of asphalt. This tendency was very marked in the case of some of the lighter weights which were surfaced with talc or soapstone. In this respect, the embedding of slate or rock granules in the top coating of asphalt, slightly increases the fire resistance, and reduces the liability to communicate fire.

Asphalt-Saturated Rag Felt Shingles.

The material from which asphalt-saturated rag felt shingles are made is the same as that used in the heavier weights of slate- or rock-surfaced roll roofing. In the samples of shingles tested, the weight of the material in single thickness varied from 74 to 103 pounds per 100 square feet. When laid overlapping the weight varied from 131 to 277 pounds per 100 square feet of roof surface.

Twenty-three samples of shingles were tested, and the results in general showed a considerable increase in fire resistance over roll roofing. The great majority of these samples failed under brand "B," after successfully withstanding brand "A-1." Two samples which are laid in such a manner that about 50 per cent of the roof surface is covered with one thickness of material only, failed under brand "A-1." This type of shingle was found to have no more fire resistance than similar material in roll roofing. Two samples of the heavier weight of shingles consistently withstood the action of brand "B," but failed under brand "C." With regard to these two samples, it was noted that the material is so laid that in no case is the roof surface covered with fewer than two thicknesses of material. This would appear to have considerable bearing on the fire resistance of this type of roofing.

In the flame test, this type of roofing failed by the flame appearing on the under side of the deck in from 15 to 45 minutes. Occasionally small burning particles were detached from the deck, but, as in roll roofing, these were not thought to be of a dangerous nature.

The tendency for fire to spread over the surface was not marked in this type of roofing. In this respect it was found very similar to slate- or rock-surfaced roofing.

Asphalt-Impregnated Asbestos Felt Roll and Sheet Roofing.

Of this material four samples were tested, and the results showed a wide range of fire resistance. One sample, composed of one thickness of asphalt impregnated asbestos felt, coated on both sides with asphalt and surfaced with talc, failed under the action of brand "A-1." In this respect it acted similarly to rag felt roll roofing, but under the flame test more resistance to fire was shown. Another sample similar to the above, except that it was surfaced with granulated slate, withstood the action of brand "A-1," but failed under brand "B." In the flame test this one also showed an increase in fire resistance over similar material made of rag felt.

The remaining three samples tested were made up of three and four thicknesses of asphalt impregnated asbestos felt, cemented together with asphalt, but without surface coating of any kind. In the brand test failure did not take place until brand "C" was applied, although the deck boards were charred more or less under the action of brand "B." In the flame test two of the samples withstood the action of the flame for 40 to 50 minutes before flame appeared on the under side of the deck. In the case of the sample composed of four thicknesses of felt, failure had not occurred at the termination of one hour. In the above three samples there was no appreciable spread of fire beyond the area directly exposed, and as the roofing remained more or less intact, no burning particles were produced.

Asphalt-Impregnated Asbestos Felt Shingles.

This type of material is similar to asphalt-saturated rag felt shingles, except that asbestos felt is used. One sample only was tested and the results showed an increase in fire resistance over the rag felt type of shingle. In the brand test, it resisted the action of brand "B," but failed under brand "C." Under the flame test, failure took place in 45 minutes. No burning particles were produced and the spread of fire over the surface was not great. In this respect this type of shingle is similar to the rag felt.

Sheet Metal.

In the sheet metal class of roofing, seven samples of galvanized iron shingles were tested, two of corrugated galvanized iron, and one each of plain galvanized iron and of copper roofing.

The results, especially of the flame test, showed very little difference between the various samples of this type of roofing. In the brand test, all samples failed under brand "B" with the exception of corrugated galvanized iron, which failed under brand "C." On account of the incom-

bustible nature of this material it does not produce burning particles nor carry fire over its surface.

Asbestos Cement Shingles.

Two types of asbestos cement shingles were tested, namely, the "American" and the "French" or hexagonal type. In the former the material is laid in the ordinary manner of wooden shingles, giving several thicknesses of material over the roof boards, but in the latter, the greater part of the roof is covered with one thickness only.

The "American" type, under the action of brand "C," provided complete protection to the deck boards, but in the flame test the deck boards ignited and failure took place by flame appearing on the under side of the deck in about 55 minutes. The hexagonal type failed under brand "C," but in the flame test failure had not taken place at the termination of one hour, although the deck boards were charred considerably.

In both the above types, cracks were produced in the shingles by the flame and brand "C" test, but these were not of a serious nature.

Slate Roofing.

The slates tested were manufactured in Pennsylvania. Each slate measured 7 in. by 14 in., and the roof weighed about 700 lbs. per roofing square when laid.

These slates proved to have a high degree of fire resistance. Under the action of brand "C," the deck boards were charred slightly, but flame did not appear on the under side. The same is true of the flame test, when the flame was applied continuously for one hour. As in the case of asbestos cement shingles, cracks appeared in the slates while under the flame and brand "C" tests, but as the slates remained in place they were not considered serious.

Asphalt Asbestos Built-up Roofing.

The samples of this material were prepared in the laboratory by the manufacturer, according to the standard specifications supplied, and under the inspection of a member of the laboratory staff. Four samples in all were tested, two designed for use on wood sheathing, and two for use on non-combustible roof surfaces.

Briefly the method of applying this roof is as follows: First a heavy base sheet of asphalt impregnated asbestos roofing felt, weighing about 60 lbs. per square, is secured to the deck boards with nails, or in the case of non-combustible roof decks, with asphalt cement. This is then mopped with hot asphalt cement, in which is embedded 14 lb. sheets in one- and two-ply construction. The surface is then given a coating of asphalt cement, but no other surfacing material, such as gravel or slag, is used.

To represent a non-combustible roof deck, special decks were prepared in which asbestos board was substituted for the wood sheathing. These decks were tested with the flame and brand "C," but little information was found beyond the fact that the roofing was practically destroyed in the area directly exposed. On account of the nature of the sheathing used no charring was produced and flame did not appear on the under side of the deck.

The samples designed for use on wooden sheathing were tested in the usual manner. In the brand test, failure first took place under brand "C." In the flame test, flame appeared on the under side of the deck in about 45 minutes. While under test, large quantities of smoke and flame were produced by burning of the surface coating of asphalt cement but no particles were detached from the deck.

Pitch-and-Gravel Built-up Roofing.

Two samples of this type of roofing were tested, namely, four- and five-ply. As in the case of other built-up roofings, the samples were prepared in the laboratory by the manufacturer, under the inspection of a member of the laboratory staff.

Briefly the method of preparing the roofing is as follows: First one thickness of dry sheathing paper is laid over the deck boards. This is followed by two thicknesses of tarred felt, laid in two-ply construction. Over this a coating of pitch is applied. Next, two (three in the case of 5-ply) thicknesses of tarred felt are applied, each cemented to the preceding one by a coat of pitch. Over all a coating of pitch is applied in which is embedded 400 lbs. of gravel per 100 square feet of roofing surface. Actually the weight of gravel varied from 200 lbs. to 440 lbs. per 100 square feet in the samples tested.

Under test, both the four- and five-ply withstood the action of brand "C" without the deck boards taking fire, although these were charred. In the flame test, the deck boards took fire in 55 minutes, in the case of the four-ply. The five-ply had not failed at the termination of one hour. No burning particles of roofing were detached from the deck and the fire did not spread appreciably beyond the exposed area.

The Standard Tests and Their Aim.

Any attempt to grade roofing materials, with respect to their fire resistance, must take into consideration the different types of fire hazard to which a roof may be subjected, the varying degrees of intensity of such exposure and the atmospheric conditions which tend to modify it. The roof may be subjected to the direct flame of an adjacent burning building, radiant heat from a near-by fire, or burning brands from buildings at some distance. Direct flame or radiant heat exposure may be

local or may extend to the whole roof. Burning brands may vary from small sparks to the largest burning fragments which can be carried by a strong wind.

Long periods of dry weather preceding the exposure have considerable influence on the fire resistance of some types of roofing while others are unaffected. The wind velocity prevailing at the time of exposure greatly affects the burning of some materials. Some materials burn more readily with low wind velocity, while the reverse is known to be true of others.

After ignition, a roof covering may or may not produce burning brands, communicate fire to other parts of the building or otherwise increase the fire hazard. Here again the wind velocity may have considerable influence. Renewals and repairs necessary to keep any type of roofing in the best condition as regards fire resistance must also be considered.

An exhaustive investigation of the fire resisting qualities of roofing materials would necessarily include tests to cover all the above-named conditions. Even if such a course were practicable, the limited time at the Committee's disposal would not permit it. In the method of testing adopted by the Committee, certain standard conditions are established and all materials are subjected to the same tests. This procedure has been followed by other investigators, and seems to give reasonably satisfactory results.

To stimulate direct flame exposure the flame from a gas burner is used. As the flame is limited in size and is not accompanied by appreciable radiant heat, this test could be criticised as not representing an actual flame exposure. However, it is impracticable to reproduce in the laboratory all conditions obtaining in practice. It is the opinion of the Committee that the results of the flame test adopted provide a sufficient basis from which to draw reasonable conclusions as to the action of roof coverings under actual flame exposures.

The experience of other investigators in making radiant heat tests on roofing materials has shown that little information can be obtained in this manner, and, as the apparatus necessary to carry out such tests is costly and cumbersome, the Committee has made no attempt to reproduce this type of exposure. It should be noted that radiant heat tests have been abandoned by the laboratory most instrumental in adopting them originally.

The brand test represents the exposure to which a roof is subjected when burning particles of wood or other material, originating in a burning building, are deposited on its surface by the wind. Of the brands used in this test, the smallest represents a reasonable size of burning fragment which could be transferred by the wind from one building to another. The next larger brand represents the exposure to which a roof

might be subjected, in this way, in extreme cases. The two remaining are of such size and weight that it is not reasonable to suppose that they could be carried by any wind, short of a hurricane. However, a roof may be so situated relative to a burning building that pieces of such size may fall upon it. At any rate, experience has shown that these large brands are helpful in determining the relative quality of materials which differ widely in fire resistance, and thus they serve a useful purpose.

The artificial wind used in testing is maintained at a uniform velocity of twelve miles per hour. In order that tests might be comparable, a uniform velocity had to be adopted. Experience has shown that a velocity of 12 miles per hour is quite suitable for this purpose. Natural wind velocities are often greatly in excess of this. Even on days when the average velocity is relatively low, the gustiness to which natural wind is subject will produce intervals of relatively high velocity. Apart from the velocity, the artificial wind used differs from natural wind in that it has not the same tendency to detach burning particles of roofing from the deck. This is due to the constant direction in which the artificial wind strikes the roofing, tending to hold loose particles on the deck rather than detach them. Owing to discrepancies between the artificial wind used in testing, and natural wind to which a roof would be exposed in an actual fire, care must be taken in interpreting the results of the Committee's tests, especially with regard to the production of burning fragments.

As mentioned elsewhere in this report, many special tests have been made under conditions differing from the standard. The results of these tests have been of material assistance in arriving at conclusions as to the behaviour of roofings under other than standard conditions of test, and as to whether or not any of the results obtained were due to the particular conditions adopted as standard.

Grading of Roofing by Fire Resistance.

In the standard methods of conducting tests, provision is made for recording sufficient data to describe accurately the behaviour of any roofing. At the time this procedure was adopted, it was not known just what information would be most useful in grading roofing. From time to time, as testing proceeded, all data recorded was tabulated in convenient form, and considerable study devoted to working out a satisfactory method of grading. This has not proved to be as easy a task as was at first anticipated. The lack of agreement between results of repeated tests of the same material soon led the Committee to the conclusion that considerable judgment would have to be exercised in interpreting all test results.

While it is obviously undesirable that the classification of any particular sample should depend exclusively on the judgment of the engineer

conducting the tests, it has been found impossible to obviate this necessity altogether.

Uniformity in the results of tests made on certain materials of the same type seems to indicate that a mechanical method of grading might be devised, were it practicable to subject each sample to the numerous additional tests required. However, in the method of grading adopted, standard test results are all that are necessary to place the majority of roofings in relative order of merit, as regards their fire resistance. It is only in cases where this method obviously places a material in the wrong class, that the judgment of the engineer is called into play.

Many of the variations found in the results of the tests can be traced to the fact that roofing is tested on wooden decks. While the wood for these decks is selected, so as to be free from major defects, and dried to an approximately constant moisture content, it is impossible to make them absolutely alike. This has been demonstrated in the laboratory, by subjecting uncovered decks to the flame test. The time required for the flame to burn through the wood varies considerably.

Brands, on certain types of roofing, will consume the roofing in the neighborhood of the brand and the deck boards will be set on fire. The fire usually burns through the deck, and develops into a rapidly spreading flame on the under side. Occasionally, however, the fire will burn itself out without going through the deck boards. From the point of view of the final result, there may be a great difference in the effect of the same brand on different samples of the same material. This difference can hardly be ascribed to the roofing material, and is perhaps explained by variations in the wood composing the deck, or other uncertain conditions incidental to the method of preparing the sample.

Possibly some of the variations found in testing could be overcome by substituting a material of greater uniformity for wood sheathing. This suggestion meets with the objection that samples so prepared do not represent actual conditions. Open-back wood decks are also out of the question for the same reason, as roofing manufacturers invariably recommend the use of closely-spaced sheathing, and wisely, as special tests (*see* "Research Investigations," in this report) have shown that the spacing of the roof boards has a considerable influence on the fire resistance of the covering.

The method of grading used in the preparation of Table V consists in first dividing all roofings into *types,* as wood shingles, asphalt rag felt roll, etc. The test results and physical data regarding all samples belonging to any one type were tabulated. From a study of this information the various samples of any one type may be placed in order of relative merit without great difficulty. The next step is to rank the different *types* of

roofing with respect to one another. This is not so easy. Roofings differing in the materials used in their manufacture, act differently under test. Factors which govern grading in one type must give precedence to others when another type is under consideration.

In grading the various samples of roofing of any one type, it is found that they may be divided into classes according to the brand which causes failure. As this seems to apply equally well to all types, it is taken as a starting point for all materials. Further classification is arrived at after consideration of the remaining items of the test data. Thus a general method was arrived at.

A study of the roofings graded according to this method, showed that certain conditions invariably occurred together, so that one would serve as an index to several. This permitted the reduction of the number of factors that would have to be taken into consideration from many to few.

The method in its final development is as follows:—

1. Roofings are divided into five major classes according to the brand, if any, which causes them to fail, *i.e.* the brand (*a*) setting a fire that burns through the roof boards, or (*b*) consistently consuming the roofing in the neighborhood of the brand, exposing and setting a fire to the roof boards which burns itself out before reaching the under side of the deck.
2. These major classes are subdivided according as to whether or not dangerous burning fragments are produced.
3. Each of the resulting groups is again subdivided according as to whether or not the material comprising the roof covering is combustible or non-combustible.
4. The individual members of the last subdivision are arranged in the order of time of burning of first thread in the flame test. For this purpose, intervals of one minute are taken and all materials whose thread-failure time falls within one interval are considered equal.
5. Finally, the materials are arranged according as to whether or not there is a marked tendency for the fire to spread over the surface of the roofing when tested under brand "A".

On account of the fact that the above method of grading has been developed from a consideration of a limited number of roofing materials only, it might have to be altered if the work were extended to include types not yet tested. However, it is the opinion of the Committee, that, if future experience should make it desirable to change the method of grading, the final arrangement of the materials would not differ greatly from that given in Table V.

The choice of roof covering from a fire prevention point of view, must take into consideration the type of building to which it is to be applied. The roofing should be in keeping with the importance and cost of the building. The location of the building will determine the maximum fire exposure to which it may be subjected. Buildings in congested areas

of cities will often be called upon to withstand the severest kind of fire exposure, while isolated buildings in the country districts will generally require protection from burning brands only, and often not even that. Intermediate conditions exist in districts where buildings are separated from one another, so that direct flame exposure is not possible and the exposure to radiant heat is small.

Roof coverings capable of withstanding the severe exposure of direct flame and intense radiant heat will necessarily provide protection against burning brands. On the other hand, results of the Committee's tests have shown that while many types of roofing will provide protection against burning brands, their nature is such that they do not successfully withstand the action of direct flame. From roofing capable of resisting severe direct fire exposure, to that which will provide protection from brands only, there is every grade. In Table V an attempt has been made to arrange the roofing materials tested in their order of merits as regards fire resisting qualities only.

It might be well to call attention here to the fact that all tests carried out by the Committee thus far have been made on new materials. Efforts have been made to secure samples of old roofing, but to date these have met with little success. Several samples of old tar-and-gravel roofing have been secured through the courtesy of W. Lajeunesse & Co., Montreal, P. Q., wrecking contractors, but these have not yet been tested. Other than this, the efforts of the Committee have produced nothing more than promises of co-operation.

The attempt to gather information on actual roof fires by means of a questionnaire circulated throughout the Dominion, has also been unsuccessful. At first the number of replies returned to the Committee was encouraging and gave promise of producing information of value, but in the last two years the number received has been so small that they are practically useless. It is to be regretted that this effort of the Committee has not received more support.

TABLE V

Grading of Roofing Samples Tested in Order of Decreasing Fire Resistance.

GROUP I.

Will give protection against severe fire exposure.

This group includes 12 samples of roofing classified as follows: 1 Slate; 2 Corrugated Asbestos Cement; 2 Asbestos Cement Shingle; 2 Pitch and Gravel, Built-up, 4- and 5-ply; 2 Asphalt Asbestos Built-up; 2 Asphalt Asbestos Felt Sheet Roofing; 1 Asphalt Asbestos Felt Roll Roofing.

GROUP II.

Will give protection against large burning brands, and direct flame for limited time. Will not produce any burning brands.

This group includes 11 samples of roofing, classified as follows: 2 Corrugated Iron Sheets; 7 Galvanized Iron Shingle; 1 Sheet Copper; 1 Galvanized Iron.

GROUP III.

Will give protection against large burning brands, and direct flame for limited time. Will not produce dangerous burning brands.

This group includes 23 samples of roofing, classified as follows: 21 Asphalt Rag Felt Shingle; 1 Asphalt Asbestos Felt Shingle; 1 Asphalt Asbestos Felt Roll Roofing.

GROUP IV.

Will give protection against small burning brands, but not against direct flame. Will not produce dangerous burning brands.

This group includes 42 samples of roofing, classified as follows: 2 Asphalt Rag Felt Shingle; 39 Asphalt Rag Felt Roll Roofing; 1 Asphalt Asbestos Felt Roll Roofing.

GROUP V.

Will not give protection against small burning brands or direct flame. Will not produce dangerous burning brands.

This group includes 18 samples of roofing, all of the Asphalt Rag Felt Roll type.

GROUP VI.

Will not give protection against small burning brands or direct flame. Will produce dangerous burning brands.

This group includes 8 samples of roofing, classified as follows: 6 Red Cedar Shingles; 2 White Cedar Shingles.

Research Investigations.

In addition to the routine work of the laboratory, special investigations have been undertaken from time to time. These have been either for the purpose of developing improved technique in the routine tests, or to determine whether or not certain common practices in the use of roofings should be investigated. The following fall in the first category:—

1. Flame Tests with Constant Wind Velocity and Variable Temperatures.
2. Flame Tests with Constant Temperature and Variable Wind Velocities.
3. Brand Tests with Open-back Decks.
4. Brand Tests on Wood Shingles with Low Wind Velocity and with No Wind.

In the second category are the following:—

1. Brand Tests on Wood Shingles Laid Close.
2. Brand Tests on Roll Roofing Laid Over Wood Shingles.
3. Brand and Flame Tests on Wood Shingles Laid Over Asbestos Paper.

Flame Tests with Constant Wind Velocity and Variable Temperatures.

The standard temperature of "wind" adopted by the Committee at the beginning of its work was 20 degrees Centigrade. A considerable experience with the furnaces installed for heating the wind showed that it was not practicable to maintain this temperature closely under all atmospheric conditions. It is very doubtful if any heating system of reasonable cost would function more satisfactorily than the one in use.

These variations in wind temperature gave rise to speculation as to their effect, if any, on the fire tests in which they were used. In order to clear up the matter, therefore, a series of flame tests was run with wind temperatures of minus 12, minus 1, plus 20 and plus 28 degrees Centigrade. A brand of roofing which had given consistent results in routine tests and could be easily secured was used, and four decks were tested at each temperature.

The results are much as one would expect. In general, the higher the temperature, the shorter the time for thread failure and for deck failure as well. Since the maximum variation in wind temperature in routine tests does not exceed 8 degrees Centigrade below, or 4 degrees Centigrade above the standard of 20 degrees Centigrade, the maximum error which might ensue from this variation is about 1.4 per cent. This error is as likely to be in one direction as in the other. Moreover, the maximum variation in wind temperature occurs but seldom, the usual variation from the standard being less than the maximum. In view of the fact that there are other unavoidable sources of error in conducting fire tests of roofing, which can only be estimated since they are not susceptible to measurement, the Committee regards the errors due to variation in wind temperature as of little moment.

Flame Tests with Constant Temperature and Variable Wind Velocity.

The erratic behaviour of single varieties of roofing under identical testing conditions, and the inconsistent results obtained from comparative tests of different varieties, led the Committee to investigate the effect of wind velocity on test results, the other variables remaining constant. For this investigation, the same brand of roofing was used as in the tests described in the preceding paragraphs. Wind velocities of 6, 12 and 21 miles per hour were used, and one series was run under the natural draft of the testing room, which could not be measured, but which was very small.

The results of this series of tests are according to expectations, *i.e.*:—the time for both thread and deck failure decreases as wind velocity increases, with the rate of change much the greater for the time of deck failure. However, as a study of these test results did not

indicate that any more consistent or instructive data could be expected with wind velocities different from the originally adopted standard of 12 miles per hour, the latter was not changed, but is still adhered to.

Brand Tests with Open-back Decks.

Occasionally, brand tests have not been entirely satisfactory, yielding rather inconclusive results. In the hope that the line between failure and no failure might be clearly defined, some tests were made on roll roofings mounted on "open-back" decks. These decks had cracks varying from $\frac{1}{16}$ in. to $\frac{1}{8}$ in. in width left between their boards. Brand "A" was used in all cases.

The results are quite comparable with those obtained from the same materials on the regular type of tight deck. One would expect that cracks between the deck boards would add to the combustibility, and in all probability this would be the case, were such cracks to remain open. However, the first effect of heating roll roofing is to melt the impregnating compound, filling any small cracks which might exist, so that thereafter an "open-back" deck is to all intents and purposes tight.

To investigate this point further, decks were prepared with boards spaced $\frac{1}{4}$ in. apart, covered with the same materials as in the previous test, and tested in the same manner.

The results of the tests on these decks confirmed the belief first held that such openings between the boards would add to the combustibility of the roof. The brands set fire in practically every case. The melted impregnating material flowed into the cracks, but on account of their greater width, sealing was prevented and the flame was allowed to reach the under side of the deck boards, after which it spread rapidly.

The makers of prepared roofing invariably recommend that sheathing boards shall be laid close, preferably, tongue-and-groove, so that the above conditions would hardly be found in practice. Moreover, the results of these tests would seem to indicate that such recommendations should be adhered to if the roofing is to give the best service of which it is capable as regards fire resistance.

Brand Tests on Wood Shingles with Low Wind Velocity and with No Wind.

A number of tests have been made from time to time by various agencies of wood shingles of one sort or another. The majority of such tests have been made in the open, with no artificial wind, or with one of very limited velocity, and the results have generally been more favourable than any the Committee has obtained in its laboratory under its standard conditions. One series of brand tests was therefore run with a wind velocity of 6 miles per hour, and one with no wind. Brand "A" was used in both cases. The results were inconsistent among themselves, and

did not agree well with the published results of other investigations. They did, however, show how susceptible to the influence of wind wooden shingles are. Of ten samples tested with no wind, not one burned through the deck, the ignited area going out of itself in from ten to twenty minutes after the flaming brand was applied. In two samples out of six tested with a six mile wind, the decks burned through in from thirty to forty-five minutes. In the four other cases, the fire burned itself out without burning through the deck.

Brand Tests on Wood Shingles Laid Close.

While conducting brand tests on the first set of wooden shingles, which were of British Columbia red cedar, it was noticed that the points of greatest weakness in this type of roof covering seemed to be the open joints between the abutting shingles in the same course. It was here that the fire almost always got its foothold. If, therefore, these openings could be eliminated, it seemed that the fire hazard of a wooden shingle roof might be decreased. Samples of British Columbia red cedar shingles laid with tight joints, and others in which the spacing was restricted to $\frac{1}{8}$ in., were therefore prepared and tested.

The results of these tests, contrary to expectations, did not differ from those obtained in testing wooden shingles laid in the ordinary manner, and it was therefore concluded that the spacing of the shingles had little or no effect on their fire hazard.

Brand Tests on Roll Roofing Laid Over Wood Shingles.

In covering old wooden shingle roofs with prepared roofing, the wooden shingles are sometimes left in place and the prepared roofing laid directly over them. To determine the fire resistance of such a roof, decks were prepared and tested with burning brands, under standard conditions of testing.

Standard decks were used and first covered with white cedar shingles. Five decks in all were prepared; two were covered with asphalt rag-felt roll roofing, talc-surfaced, weighing 45 pounds per square, one covered with asphalt rag-felt roll roofing, sand-surfaced, weighing 80 pounds per square, and two covered with asphalt rag-felt slate-surfaced strip shingles weighing 192 pounds per square. These brands were used merely because they were on hand.

The decks covered with roll roofing took fire quickly under the action of the smallest brand (Brand "A"). The fire spread rapidly over the deck and gave off burning particles of shingles and asphalt roofing. The decks covered with asphalt shingles withstood the action of brand "A," but one of the decks took fire when tested with brand "A-1." The fire did not spread as rapidly in this case as in the case of roll roofing.

The roll roofing used in the above, under standard conditions (roofing laid directly over decks without wooden shingles), withstood the action of brand "A." In the case of the 45 pound roofing the deck boards were charred slightly, but no charring was produced in the case of the 80 pound roofing. The asphalt shingles which failed in the above case under the action of brand "A-1," successfully withstood this brand when tested under standard conditions.

Covering an old wooden shingle roof with prepared roofing, either in roll or shingle form is, on the basis of these tests, an unsatisfactory procedure from the standpoint of fire resistance. The resulting roof is more hazardous than similar types having the prepared roofing laid directly over the roof boards. A combination wooden shingle and roll roofing is far less fire resistant than a roof covered with new wooden shingles alone, but the laying of a good grade of prepared shingle roof over a new wooden shingle roof, appears to add to its fire resisting qualities.

Brand and Flame Tests on Wood Shingles Laid Over Asbestos Paper.

These tests were made on standard decks of tongue-and-grooved dressed sheathing, laid with close joints. Asbestos paper was placed between the deck boards and the shingles. Two weights of paper were tried, known to the trade as $\frac{1}{16}$ in. and 10 lbs., with both white cedar and red cedar shingles. The decks were subjected to the standard flame and burning brand tests.

In no case was complete protection provided by the asbestos paper. In the case of the brand tests, whether or not any fire at all resulted depended on whether or not the shingles themselves took fire sufficiently to burn through to the asbestos. In all cases where fire reached the asbestos, the deck boards were charred more or less. In a few cases, with red cedar shingles the fire went out on reaching the asbestos, but in no case did the fire go out of its own accord in white cedar shingles. In the case of about 50 per cent of the tests, no flame appeared on the under side of the deck until the fire had spread to the bottom of the deck and worked its way around the lower edge of the asbestos paper. In the rest of the flame tests, no flame at all had appeared on the lower side of the deck in one hour.

From the manner in which the deck boards were charred it was thought that if the decks were made with boards slightly spaced admitting air under the asbestos, flame might appear on the under side of the deck.

Two decks were therefore prepared with boards spaced from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. One was covered with red cedar shingles and the other with white cedar shingles. Asbestos paper $\frac{1}{16}$ in. thick was used on both decks.

While under test these decks gave off large quantities of smoke through the cracks, but, although the deck boards charred, no red coals could be seen. Immediately after the end of the test the asbestos was cut and the deck boards examined. These were found to be charred to a considerable depth, but showed red coals only when the asbestos was removed, admitting air. It would appear that the boards charred without igniting.

Although the asbestos paper will not prevent a wood shingle roof from taking fire, it would appear from the results of these tests that it will hold fire in check by preventing flame reaching the under side of the deck. It has been the experience in all the tests that this is the critical point in the development of a roof fire. After the fire reaches this stage, it spreads rapidly and it is only a matter of minutes before the whole deck is enveloped in flame. If this holds true for outside conditions, the placing of asbestos paper under wood shingles has this to recommend it.

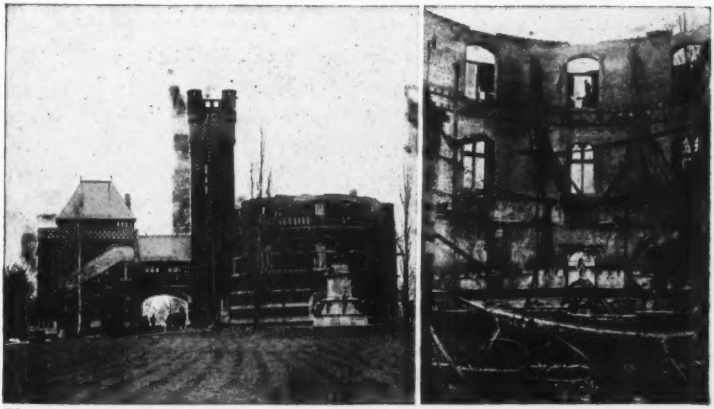
The flying brand hazard, however, remains unchanged as the asbestos does not prevent the spread of fire in the shingles themselves.

Shakespeare Memorial Theatre Fire.

The Shakespeare Memorial Theatre, built at Stratford-on-Avon nearly fifty years ago by admirers of the greatest English poet, was destroyed on March 6, 1926, by a fire which started at the rear of the stage from an unknown cause.

The fire was discovered about 2:30 P. M. by a workman who had been in the theatre during the morning and was then returning to it from lunch. He attempted to enter by the stage door to reach the hydrant and hose within, but was driven back by the dense smoke. The alarm was then sounded at 2:48 P. M. and eight minutes later the Stratford Fire Brigade arrived. In the meantime, townspeople had gathered and rendered heroic service in salvaging the contents of the museum and library. Valuable Shakespearian relics, including the Droeshout original portrait of the poet, were safely removed.

It was immediately apparent that the small force of the local brigade was inadequate to cope with the fire, and a general alarm was circulated. Brigades from five nearby towns responded with horse-drawn steamers



Photographs, Copyright, The Times.

Left—View showing the extent of the destruction of the Shakespeare Memorial Theatre. Firemen were able to prevent the spread of fire through the bridge to the museum and library on the left. Right—View from the stage looking into the auditorium showing the twisted ruins of the interior of the theatre.

NOTE: This article was prepared from data furnished by Mr. D. W. Wood (Member N.F.P.A.), London.

and motor turbines. Suction was taken from the river close by, and hose connected to town mains, but pressure from the latter source was found to be low. With six engines at work, water was being pumped into the building at the rate of 2,000 gallons a minute. But the great amount of timber in the interior construction, dry with age, had spread the fire with such rapidity that all efforts to control it were in vain.

The firemen then directed their energies to saving the other buildings in the group. The theatre tower connected with the museum and library by a bridge, the opening through which was guarded by a "fireproof" door. Water was pumped upon this door which, reports say, was often alight and eventually reduced to charcoal. The museum and library, however, were saved.

The theatre and tower were completely gutted. One hour after the start of the fire, the floors and galleries had given way, and an hour later the roof fell in. When the fire had burned itself out, only the shell of the tower and the lower walls of the auditorium remained standing. Some few treasures were burned in the theatre: prints and playbills, a celebrated drop-scene painted by Beverly, and the entire wardrobe, the valuable portion of which had been presented to the memorial by Mr. E. H. Sothern.

Sprinklers Check Garage Fire.

Report by Underwriters' Bureau of New England.

(Member N. F. P. A.)

It is often said that "a fireproof garage needs no sprinkler system." This contention was disproved on the night of January 15, 1926, when a fire in an automobile in such a garage in Pittsfield, Mass., was prevented from spreading to other cars by the efficient operation of sprinklers.

The garage was of one-story construction with a small basement. The walls were of brick, the finish open. The floors were concrete on earth.

The sprinkler system was installed in 1922. The spacing and arrangements of sprinkler heads was 8 ft. or better in 12 ft. bays between steel trusses. The pipe sizes were 1, 2 and 3. The system was supplied by an 8 in. street main at a pressure of about 95 pounds. An alarm service consisting of a rotary gong was attached to the alarm valve on the system.

The fire started in a Chevrolet two-door sedan, presumably from a short-circuit in the ignition system. No one was on the premises at this time. When the fire had burned through the top of the car, the sprinkler head directly over it operated, producing the effect of a water curtain about the car and confining the fire damage almost entirely to its interior.

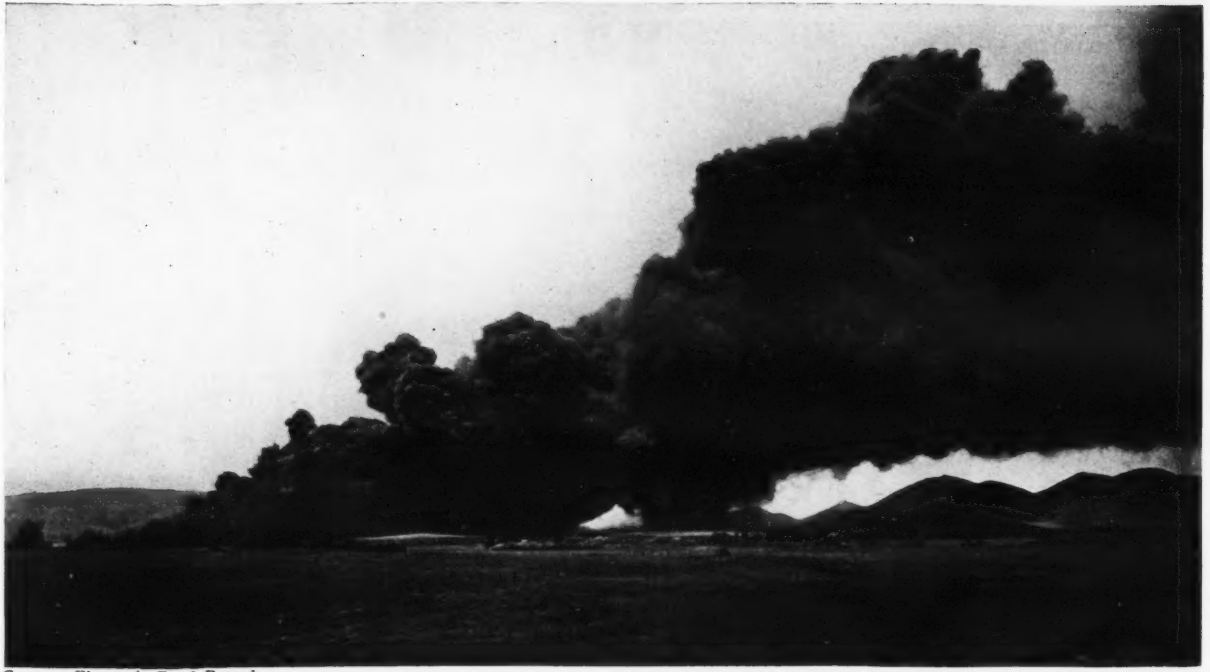
Courtesy Edward N. Harriman (Member N.F.P.A.)

In this fire in a Pittsfield, Mass., garage, a fire originating in a closed car was confined to its point of origin by the operation of three sprinklers. The complete burning of the interior of this car affords evidence of what might have happened to the other cars in the garage but for sprinkler protection.

The cars on either side suffered but slight scorching which necessitated retouching. The rotary gong sounded properly and was heard by tenants next door; but as they did not understand the significance of the alarm, they did not immediately transmit warning to the garage owner.

When he finally arrived, water was running from three sprinkler heads. The fire had burned itself out, rendering the Chevrolet a complete loss, but not extending beyond point of origin. Damage of about $100 resulted from water flow, but this was mostly labor cost of cleaning up.

It is obvious what would have happened in this fire but for the sprinkler protection. The Chevrolet was in a row of automobiles which were separated from each other by a space of from one to two feet. It is reasonable to assume, then, not only the loss of many cars, but possible extensive damage to the garage itself from the terrific heat which would have been generated.



Courtesy Fireman's Fund Record.

The Union Oil Company Tank Farm Fire at San Luis Obispo, California. This photograph shows one of the first reservoirs to burn, and the roofs of two others which burned later. Farm buildings in foreground were destroyed by cyclones caused by explosion of these two tanks. This picture shows also the general contour of the land on which the 300-acre tank farm is located—slightly sloping but nearly level with low hills on the north and east.

Union Oil Company Tank Farm Fire.

Report by Board of Fire Underwriters of the Pacific.

(Member N. F. P. A.)

The worst oil fire in history started on the morning of April 7, 1926, in San Luis Obispo County, California, when three reservoirs of crude oil on the storage farm of the Union Oil Company were simultaneously ignited by lightning. The fire is an aftermath of the recent overproduction of oil. With excess quantities of crude oil rapidly brought out of the wells, containers had to be provided; steel tankage being out of the question, recourse to reservoirs resulted. Those at San Luis were 6 in number, concrete-lined earth banks, over 20 feet deep, with roofs of tar paper on wood on wooden posts on concrete piers. They held variously from 750,000 to 1,000,000 barrels each. The tanks, nineteen in number, were steel shells with tops of wood covered with roofing felt in good condition. They had eight inch breather vents of galvanized piping, double-valved, which, of course, would not relieve explosions of even mild proportions. The fire burned for five days and destroyed approximately 5,000,000 barrels of oil valued at about $7,000,000.

The few eye-witnesses of the start of the fire seem to be agreed that reservoirs Nos. 5, 6 and 7 (see diagram), were practically simultaneously ignited. Terrific explosions attended a flash of lightning which appeared to make a direct hit in the midst of the southwest part of the farm. A water pipe valve afterward found between reservoirs Nos. 5 and 6 seemed to have received a lightning bolt. A separate but less severe explosion blew up the roof of reservoir No. 3 about fifteen minutes later. It is not known how this reservoir was ignited.

Aside from some few mild slop-overs, the first boil-overs came seventeen hours after the start of the fire, the heavy crude oil in reservoir No. 2 and tanks Nos. 12, 14, 16 and 18 being thus ignited. Flying brands from reservoir No. 2 may have started reservoir No. 4. The next day reservoir No. 2 boiled over, but apparently did not ignite any more tanks.

It was then hoped that the remaining tanks, which set further back, would escape. But on the night of the second day reservoir No. 4 boiled over, pouring burning oil directly in the midst of the group. Progress of the fire among the tanks could not be clearly seen because of smoke until the morning of the third day. It was then found that seven tanks at the northeast corner were intact. About midnight, however, one of these took fire, and the following morning one more ignited, finally leaving but five unburned.

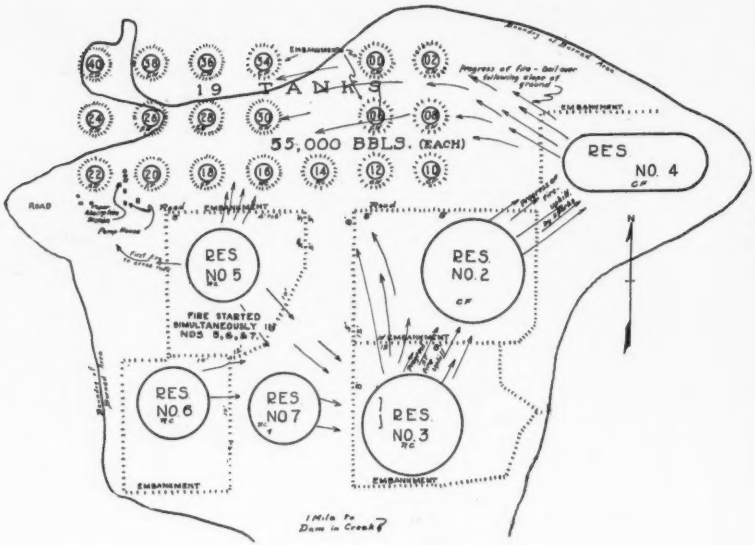


Diagram of Fire April 7, 1926.

UNION OIL COMPANY STORAGE FARM

San Luis Obispo County, California.

Scale 1 in. = 1200 ft. C.F. = Crude Fuel Oil.
R.C. = Refining Crude Oil. C.S. = Crude Naphtha.

NOTE: Slope of grounds from Reservoir No. 4, approximate high point, N.W. toward Tank No. 28, thence south. Figures on embankments indicate height in feet.

As a result of the fire, two men were killed, and a girl was injured. Besides the oil loss, five cottages were burned; two farmhouses were destroyed by blasts of wind caused by the explosions of the reservoirs; garages and automobiles were destroyed; grain farms were flooded with burning oil for a quarter mile on two sides, and a longer distance south; plate glass windows in stores in town two miles away in a straight line, but behind hills, were broken by the blast of initial explosions.

Early during the fire attempt was made to remove oil from burning reservoirs and tanks; but, except for a small salvage, this was unsuccessful because blasts from the reservoirs broke the steam lines to steam pumps, and the fire brought down electric wires putting electric pumps out of commission. About 150 men were put to work raising emergency dikes along the road between the reservoirs and the plant, in anticipation of boil-overs. While these retarded the fire-spread somewhat, they did not save the pumping plant, which was swept away early. Trucks later

Courtesy Fireman's Fund Record.

One of the large reservoirs, capacity 1,250,000 barrels, just after it started to boil over. Shows the inadequacy of the emergency trenches and how the "boil-over" jumped the ditch. Also, shows the creek by which the oil reached the ocean, nine and one-half miles away, and from there was spread over the beaches for miles up and down the coast.

brought further supplies of foam extinguishing equipment, but access for its use was not possible.

The boil-over hazard has not been measured properly even by the oil companies, whose engineers have studied oil fires closely. No doubt, practice hereafter will be to take account of the impetus due to velocity and make greater spacing around containers of undehydrated crude. Instead of keeping water at the bottom of containers, it should be kept out, even if the result is loss of oil through seepage. Present dikes are too low and not properly turned back. The main difficulty, however, is that spacing is too close, both on account of boil-overs and flying brands. It is a question whether spacing can be made wide enough to prevent simultaneous ignition by static and still have several containers on a single tract of land.

The day following the start of the San Luis Obispo fire, lightning struck and fired two reservoirs at the Union Oil Company's Stewart Station, near Brea, California. The result was a fire very similar to that recounted above, with a total loss set at approximately $3,000,000.

The Lowell Department Store Fire.

Report by Underwriters' Bureau of New England.

(Member N. F. P. A.)

A fire of unknown origin started at 4:30 P. M. on June 3, 1926, in the basement of one of the A. G. Pollard department store buildings on the north side of Middle Street, Lowell, Mass., swept through unprotected basement openings to adjoining structures of the same store completely demolishing them, communicated through the rear to the Masonic Temple next door causing the collapse of the third and fourth floors, and caused widespread smoke and water damage to many other building in the vicinity. The total loss involved is estimated at $1,500,000.

The Pollard buildings were old, but in good repair. The construction was hollow joist, lathed and plastered finish, with unprotected vertical openings. This inferior construction, absence of sprinkler protection, and the large amount of highly combustible stock in the basement were the factors responsible for the rapid spread of the flames.

The fire was discovered by an electrician working on Middle Street. The first alarm was sounded at 4:40 P. M., the second at 4:43, and a third, which called out the entire department, at 5:07. The firemen first attacked the fire in the basement where it originated, but it soon mushroomed out into the basements of adjoining buildings, becoming practically out of control. The efforts of the department were then directed to

Fifty hose streams, supplied by automobile pumpers from six cities, played steadily for over three hours before Lowell's worst fire was extinguished. (See Frontispiece.)

The intense volumes of smoke which poured out of the Pollard buildings greatly handicapped the work of the firemen.

confining the fire to the section then involved. This fight was successful except in the case of the Masonic Temple, where the fire entered the top floor through a broken skylight.

The Lowell fire department, consisting of 215 men and all the city apparatus, was assisted by the departments of five nearby cities. Fifty hose streams were in action, supplied by nine 600 gallon and one 1000 gallon automobile pumpers from Lowell, two 1000 gallon pumpers from Lawrence, and several smaller pumpers. It was said that ample water was available at all times, although one of the Lawrence pumpers took suction from the canal and several of the smaller pumpers from hydrants on the canal system located in a mill yard close by. The work of the firemen was hampered throughout by the dense smoke which poured out of the burning buildings.

The cause of the fire is unknown. At the time, the store was closed for the regular half holiday on Thursday afternoon. There were, however, eight workmen, beside the watchman, in the store making repairs. Except for the watchman, they left the building about 4:30 at which time no sign of fire was discovered. One of them, just before leaving, returned a stepladder to the basement where he had an unobstructed view of the entire floor; but he reported that no signs of fire were apparent at that time. It appears very probable that the careless use of cigarettes or matches was the cause of the fire.

The fire brings out clearly the need of automatic sprinkler protection, especially in a building of inferior construction. It also points to the danger of connecting adjoining structures without providing standard cut-offs between buildings.

Sprinkler Leakage Losses.

By Gorham Dana
(Member N.F.P.A.)

While sprinkler leakage insurance has been in vogue for many years, it is only recently that any concerted action has been taken to tabulate and study the causes for losses of this class. In 1922 the Fire Underwriters' Uniformity Association undertook to collect and tabulate data on these losses in somewhat the same way that the National Fire Protection Association tabulates the record of fire losses. A sprinkler leakage loss blank was prepared and adopted by the Association in 1923. This was circulated amongst the active members of the Association which consisted of fire insurance boards and bureaus in various parts of the country. This blank calls for data on the name and class of risk, date and location of break, cause, alarm given and loss sustained.

Information has been received by the committee in charge from nearly all parts of the country so that the results should be representative of the average conditions. The total number of reports tabulated during the past four years is 3,187, of which 683 were reported during the past year. These have been tabulated according to causes under the main headings of freezing, high temperature, mechanical injury and miscellaneous, each heading being divided into a number of sub-headings.

Those who have not studied the subject often assume that defective sprinklers cause a large proportion of the losses while as a matter of fact only about 10% of the losses are from this cause. It is also generally assumed that sprinkler leakage insurance is primarily to cover defects in sprinkler equipments rather than improper maintenance. As a matter of fact the bulk of the losses are due to maintenance causes such as lack of sufficient heat, too much heat, or mechanical injury. Only about 16% of the losses are due to defective material, settlement of buildings, windstorms, breaking belts and other causes over which the owner has practically no control.

To summarize the table of causes: freezing was responsible for 42.5% of the losses, high temperature caused 20.6%, mechanical injury 15.8% and defective sprinklers 10.2%. Amongst the miscellaneous causes may be mentioned defective pipe or fittings 2.9% and corrosion 1.6%. Defective sprinkler heads are responsible for about 10% of the losses and these include some 11 makes and a large number of different issues, mostly old issues that are no longer made. These are representative of

the various heads in common use although there are a few types that give more trouble than the average. When we consider the millions of sprinkler heads in use today, the number that give trouble in this way is remarkably small. This speaks well for the high state of development that has been obtained in the art of automatic sprinkler protection.

The table of causes is as follows:

Assigned Causes of Sprinkler Leakages.

	1926	1920-26
FREEZING, WET SYSTEMS—		
Deficient General Heat	80	408
Open Windows, Doors, etc.	40	216
Entrys, Stair Halls, etc.	29	167
Pent Houses, Blind or Low Attics, etc.	32	114
Show Windows, Sidewalk Lights, Coal Holes	15	82
Cold Weather Piping	17	63
Toilets	4	27
Tank Risers, Fill Pipes, etc.	10	21
Inspectors' Test Pipe	0	13
Totals	227	1,111
FREEZING, DRY SYSTEMS—		
Poor Alignment of Pipes	23	166
Low Point Drains in Cold Places	11	39
Tripping of Dry Valve	2	30
Dry Valve Fittings	4	9
Totals	40	244
FREEZING, All Circumstances	267	1,355
HIGH TEMPERATURE—		
Boiler Rooms, Near Ovens, Furnaces and Stacks	67	303
Dryers, in or near	45	163
Steam Pipes, Escaping Steam	35	166
Skylights	3	5
Miscellaneous	10	19
Totals—See Note *	160	656
MECHANICAL INJURY—		
By Construction, Alteration or Repair Work	34	142
Piling or Handling of Stock	37	139
Breaking of Belts and Fly Wheels	27	111
Operation of Elevators	11	45
Settlement of Buildings	4	40
Collapse of Buildings and Windstorm	16	28
Totals	129	505

(*Continued on next Page*)

*NOTE—Of 179 sprinklers opened, 1925, from high temperature 6 were 286°; 38 were 212°; and 135 were 155°. Of 160 sprinklers opened, 1926, from high temperature 7 were 286°; 30 were 212°; and 123 were 155°.

Defective Sprinklers, Alleged	48	314
Defective Fittings or Pipe	20	92
Corrosion	15	55
Leaky Tanks and Connections	8	35
Mischief or Malice	3	26
Pipes Embedded in Concrete	0	7
Leaded Joints	1	8
Inspectors' Test	0	10
Defective Hangers	0	2
Miscellaneous and Unknown	35	122
Grand Totals	683	3,187

Sugar Refineries—Fire Record.

An analysis of the reports of 114 fires recorded in the files of the N.F.P.A. Department of Fire Record in sugar refineries and sugar warehouses, shows that the hazard of this occupancy is to a considerable extent due to the combustible nature of the material handled, and its liability to flash fires and dust explosions. The largest number of fires due to any single cause, as is the case of many other occupancies, is recorded as "Smoking or Matches."

In the special hazard causes, next in importance to those related to the sugar dust, are those reported as due to spontaneous ignition of empty sugar bags or sugar stacked in bags. A feature of special interest in connection with fires in bagged sugar is the susceptibility of the product to smoke and water damage, and the comparatively small salvage that may be obtained.

Sugar is one of the more flammable of the mill dusts. That no early records disclosed accounts of serious explosions in the sugar industry is undoubtedly due to the fact that it is only in recent years that sugar has been pulverized, and that but a small amount of dust is created in the handling of the rather coarse product. Sugar of special, hard grain is pulverized, or ground into powder, between rapidly revolving rolls or by attrition mills. In the process there is created great amounts of dust, and it is essential that the dust be removed from the machine in which it originates, so as to prevent it from floating in the air and settling about the building. Fires are very often started in these machines by the action upon this sugar dust of some foreign substance in the sugar, friction or hot bearings.

Spontaneous ignition in stacked sugar in bags is an infrequent occurrence, in fact it has been thought that there was no possibility of it. However, records of several fires not only indicate a definite possibility

of spontaneous ignition, but show it to be evident that when sugar is stored in large units, a most elaborate scheme of fire protection and alarm service is necessary to prevent serious loss.

All evidence seems to point to the fact that under ordinary storage conditions sugar will not oxidize. Under favorable conditions of temperature, pressure and ventilation, however, certain chemical changes undoubtedly take place which liberate heat.

There is apparently considerable fire hazard in the drying and storage of the jute bags in which sugar is sacked. Conclusions adduced from an analysis of several fires indicate that baled bags are subject to spontaneous ignition, especially where interior bags are damp when baled.

In the October, 1917, QUARTERLY (Vol. 11, No. 2, p. 190) there is a very complete and comprehensive article describing the processes involved in the refining of sugar, and their hazards.

COMMON CAUSES.

	Refineries No. of Fires	Warehouses No. of Fires	Total No. of Fires	%
Smoking or Matches	13	9	22	40.0
Power	10	1	11	20.0
Boiler	6		6	10.6
Fuel Oil System	3		3	5.5
Heating	2		2	3.7
Exposure	2		2	3.7
Lighting	1		1	1 8
Rubbish	1		1	1.8
Oily Material	1	3	4	7.4
Lightning		1	1	1.8
Miscellaneous	2		2	3.7
Total	41	14	55	100.0

SPECIAL HAZARD CAUSES.

	Refineries No. of Fires	Warehouses No. of Fires
Sugar Mill or Pulverizer	7	
Drying	6	
Dust Explosion	3	
Grinder	2	
Sugar boiling	2	
Sugar elevator	1	
Sugar bolting reel	1	
Sugar granulator	1	
Spontaneous ignition in piles of refined bagged sugar	2	2
Spontaneous ignition of sugar bags	1	5
Spontaneous ignition of sugar char	1	
Total	27	7

Photograph by J. H. Roberts, Board of Fire Underwriters of the Pacific (Member N.F.P.A.).

Bag storage section, and partial view of warehouse of a Utah sugar factory after a fire caused from spontaneous ignition of stacked sugar in bags.

Summary of Causes.

	Refineries		Warehouses		Total	
	No. of Fires	%	No. of Fires	%	No. of Fires	%
Common Causes	41	60.3	14	66.7	55	61.8
Special Hazard Causes..	27	39.7	7	33.3	34	38.2
Total Known Causes..	68	100.0	21	100.0	89	100.0
Unknown Cause	17		8		25	
Total	85		29		114	

How Discovered.

	Refineries		Warehouses		Total	
	No. of Fires	%	No. of Fires	%	No. of Fires	%
Employee	51	67.1	17	58.7	68	64.7
Watchman	13	17.2	9	31.0	22	21.0
Sprinkler Alarm.....	7	9.2	2	6.9	9	8.6
Outsider	5	6.5	1	3.4	6	5.7
Total with Data.....	76	100.0	29	100.0	105	100.0
No Data	9		0		9	
Total	85		29		114	

Effect of Sprinklers.

	Refineries No. of Fires	%	Warehouses No. of Fires	%
Extinguished Fire	27	66.0	8	42.1
Held Fire in Check	12	29.2	11	57.9
Total Satisfactory	39	95.2	19	100.0
Unsatisfactory	2	4.8		
Total	41	100.0	19	100.0

Number of Heads Opened.

No. of Heads Opened	Refineries Wet No. of Fires	%	Refineries Dry No. of Fires	%	Warehouses Wet No. of Fires	%	Warehouses Dry No. of Fires	%	No Data No. of Fires	Total No. of Fires	%
1	4	20.0	3	15.8	2	33.3				9	15.5
2	3	15.0	2	10.4	1	16.6	1	8.3		7	12.1
3	3	15.0	1	5.3			1	8.3		5	8.6
4	4	20.0	1	5.3	1	16.6	1	8.3		7	12.1
5-10	4	20.0	9	47.5			5	41.7		18	31.0
10-25	1	5.0	2	10.4	1	16.6	2	16.7	1	7	12.1
25-51	1	5.0	1	5.3	1	16.6	2	16.7		5	8.6
No Data	1		1							2	
Total	21		20		6		12		1	60	

Note: There were fifteen fires in which no sprinklers operated.

Analysis of Loss.*

Sprinklered Fires	Refineries No. of Fires	%	Warehouses No. of Fires	%	Total No. of Fires	%
Small Loss	42	82.5	13	59.1	55	75.5
Large Loss	9	17.5	9	40.9	18	24.5
Total with Data	51	100.0	22	100.0	73	100.0
No Data	2				2	
Total	53		22		75	

Unsprinklered Fires	Refineries No. of Fires	%	Warehouses No. of Fires	%	Total No. of Fires	%
Small Loss	11	36.7	1	14.3	12	32.4
Large Loss	19	63.3	6	85.7	25	67.6
Total with Data	30	100.0	7	100.0	37	100.0
No Data	2				2	
Total	32		7		39	

*Large loss fires are fires causing damage greater than $5,000.00.

Typical Fires.

S-40259. July 6, 1925. Long Island City, N. Y. Refinery. Fire started in the bag dryer in the bag drying building, due probably to spontaneous ignition. The dryer is of all metal construction, steam heated and well vented. Bags are washed on dock, brought to the dryer building and suspended on an endless conveyor which carries them slowly through the dryer. The fire broke out near the exit and was subdued by streams from nearby standpipe hose. Loss was slight.

Photograph by J. H. Roberts, Board of Fire Underwriters of the Pacific (Member N.F.P.A.).

Sacked sugar salvaged after fire. Although the damage is limited to scorching of these bags, the sugar must be reworked, and it is estimated that but 50% will be saved.

S-30568. SEPT. 22, 1921. EDGEWATER, N. J. WAREHOUSE. The cause of this fire is attributed to spontaneous ignition in the center of a bale of bags. The second floor, where fire occurred, is occupied for storage of baled sugar bags and some barrel stock. As soon as flames were seen, alarm was sounded by the watchman. Forty-six sprinklers opened, covering an area of about 1600 sq. ft., and practically extinguishing the fire. The loss was several thousand dollars.

S-40485. OCT. 2, 1925. SOUTH BOSTON, MASS. WAREHOUSE. Fire was caused by spontaneous ignition in pile of bagged sugar. The sugar had been received hot from refinery on the previous afternoon. When the warehouse was opened in the morning, smoke was in evidence. Investigation showed the pile of sugar to be burning in twelve places. Warehouse employees and firemen extinguished the fire with hand extinguishers. The loss was slight.

H-22870. DEC. 25, 1925. SPANISH FORK, UTAH. WAREHOUSE. Spontaneous ignition in stacked sugar in bags was probably the cause of this fire in the warehouse building of a large sugar factory. The sugar, stored in solid sacks, was piled about 40 bags or 22 feet high. When first noticed, the fire was apparently burning near the top of the stack, but

it later appeared that the actual point of origin was somewhat lower. Four public department pumpers responded to the general alarm. Twice it was thought that the fire was under control, but each time there were explosions of accumulated gas followed by rapid spreading of the fire between sacks. The fire then rapidly swept throughout the entire warehouse. The loss to the building was about $25,000, and to the sugar approximately $330,000.

S-37277. APRIL 12, 1924. EDGEWATER, N. J. REFINERY. Foreign substance in one of the pulverizing machines caused the ignition of sugar dust, and a flash of fire followed. Eight sprinklers located over machinery opened, and one sprinkler under roof opened extinguishing fire. Little or no damage was caused by the fire, although the cyclone and metal ducts showed the effect of heat. There was some damage to both pulverizing machinery and finished stock.

Australian Sugar Refinery Fire.

On the night of February 24, 1926, a fire of undetermined origin broke out in the Glanville Sugar Refinery at Adelaide, South Australia, and, fanned by a high westerly wind, burst into a blaze of such proportions within half an hour that the roof had collapsed and fired the stacked bags within the building setting loose cascades of molten sugar. A short time later the galvanized iron walls collapsed, revealing a blazing mountain of sugar.

The fire was discovered by an employee on night shift. Startled by a sudden burst of light, he looked up to see an approaching wall of fire. Flames seemed to shoot along the top of a stack of bagged sugar with lightning like rapidity, soon involving the wooden roof beams. He rushed out of the building just in time to save his life, for by that time the building was a mass of flames.

The fire broke out at 6:30 P. M., the alarm was telephoned to the Port Adelaide Fire Station at 6:40, but by the time the apparatus arrived upon the scene the fire was out of all control. Efforts were then directed to preventing the fire from spreading to the lofty charhouse nearby which has been a landmark at Glanville for 30 years. The roof of the boilerhouse was the only position near the conflagration which could be occupied by the firemen. Sixteen lines of hose were brought into play, supplied by a six inch main, but the pressure was insufficient and it was impossible

View of the ruins of the Glanville Sugar Refinery at Adelaide, South Australia, after an all night fire which was probably caused by spontaneous ignition of a stack of bagged sugar.

to reach a stream to the top of the charhouse. Three Dennis motor pumps, however, taking suction from the river, were soon throwing water at the rate of 600 gallons a minute. By morning the refinery was a mass of twisted iron and debris, and the mountain of sugar was still smoldering.

The cause of the fire is not definitely known. It was first thought that the fusing of electric wires may have fired the raw sugar. The theory was then offered that the fire had started in the dry roof timbers, but the reason for this is not explained. It seems reasonable to believe that the cause was spontaneous ignition in the stack of bagged sugar. The stack, containing several thousand tons of raw and refined sugar, had been in the same position for four months. Conditions of temperature and ventilation may very well have been favorable to spontaneous ignition.

The total loss to factory, plant and stock amounts to approximately 600,000 pounds.

NOTE: We are indebted to our member, Wormwald Bros., Ltd., Port Melbourne, Australia, for the data from which this account was written.—ED.

Marsh Wood Products Co. Explosion.

By Frank R. Daniel, Chief Engineer.
Wisconsin Inspection Bureau (Member N. F. P. A.).

A dust explosion occurring on April 21, 1926, in the plant of the Marsh Wood Products Co., Milwaukee, Wis., manufacturers of interior woodwork, sash and doors, caused the deaths of five firemen, and severe injuries to fifteen others. The property loss was about $10,000.

A fire, which apparently started in unused conductor pipe holes in the brick wall of a shavings bin, worked its way back into the pile of shavings in the form of a glowing mass. Sprinklers had apparently quenched the fire, as observed by a fireman on the roof of the shavings vault, and were shut off. The corner of the bin, covered by one of the sprinklers which did not operate, was not thoroughly wet down, which fact the firemen did not know. The door at the bottom of the shavings vault in the boiler room was then opened for the purpose of emptying the contents on to the boiler room floor, and the sawdust was pulled out of this door without being wet down. The boiler room was filled with floating dust, and in the process of emptying the bin a cave was eventually formed. In this cave the alcohol fumes generated by the combustion of the sawdust accumulated.

The captain of one of the engine companies came down to the roof adjoining the boiler room three times and asked about putting a line into the top. Having detected fire in a corner of the shavings bin in which the sprinkler did not open, he was on his way down again when the explosion occurred. When the cave had been finally enlarged to a point where the fire tumbled in, the fumes inside of the vault were ignited. This slow flash apparently communicated to the dust laden air in the boiler room, and a violent explosion ensued. This theory is supported by the owner of the plant who had just entered the door to observe the work of the firemen. He says that all he can remember is throwing his arm over his eyes, and then the force of the explosion blew him back into the room adjoining. The theory is that when he saw the flash emitting from the door of the shavings vault he attempted to protect his eyes. The explosion of the dust laden air in the boiler room followed. The intensity of the heat generated by the explosion ignited the clothing, particularly rubber coats and boots, worn by the firemen. One man working on the floor of the boiler room was killed instantly; three others died within 24 hours; one died three days later; and another in about ten days. One

fireman is still in the hospital, and two are at home, convalescing. Five of those injured are back at work.

The principal injuries were seriously burned hands and faces. Eye-witnesses described the men as they came out of the boiler room as "human torches." Practically all of the men working at the fire were more or less severely burned, so that there were comparatively few who were able to give any assistance.

Fires in Which There Was Loss of Life.

These notes are intended to point out typical conditions under which loss of life has occurred that they may be known and guarded against.

H-23076. LULING, LA., JANUARY 28, 1926. SUGAR REFINERY. The cause of the fire, which originated in the old sugar room section, could not be determined. A few hours after the fire was discovered it was noticed that the watchman was missing and when a search of the ruins was made his body was found about 30 feet from a door leading to the outside. His lantern, which was of the kerosene type, was found about 20 feet away. It is thought that he discovered the fire and was trying to get out of the building to sound an alarm when he was overcome by smoke or lost his way in the excitement.

H-23141. ALGIERS, LA., MARCH 26, 1926. MASONIC TEMPLE. Two men were at work laying "T.M.B." plastic floor covering on the second floor of a fire-resistive building which had just been completed. The floor covering for the first floor had been completed the previous day. The men were using a blow torch presumably to smooth out lumps in the floor surfacing which hardens very rapidly. This torch set fire to the gasoline saturated flooring, and flames spread so rapidly that both men were seriously burned before they could escape and had to be removed from the building by other workmen. The flooring was burned and considerable damage was done to the plastering, wood doors and trim. The two men died from their burns several days later.

H-23179. SAN ANGELO, TEXAS, MARCH 7, 1926. One man lost his life in a fire which destroyed a two-story frame rooming house. The firemen on arrival visited all the rooms hurriedly, but in the dense smoke found no one. When the fire was practically under control the firemen raised a ladder to the second floor and found the man lying behind a bookcase within a few feet of the door. Badly burned, his clothing all

destroyed, he was carried to a hospital across the street where he died a short time later.

H-23402. SOMERVILLE, MASS., JUNE 3, 1926. MOTION PICTURE THEATRE. A fire, which appeared to the audience to be so slight that they refused to leave the theatre while the firemen extinguished the flames, caused the death of the motion picture operator. He died the next day from burns he received when a film exploded in the projection booth. It is thought that he was overcome at once by the smoke and intense heat from the burning rolls of nitro-cellulose film and collapsed before he could get out of the booth. Only the fire-resistive construction of the booth prevented the fire from spreading.

L-27. ADAMS, MASS., APRIL 24, 1926. A mother and three children lost their lives in a fire which destroyed their home. The fire apparently started on the first floor where the father was sleeping. He was awakened by the fire and instead of arousing the members of his family rushed out of the house to his garage, where he obtained his automobile and drove to the police station to give the alarm. In the meantime the mother had discovered the fire and made her escape. She went back into the house to rescue her children, but reached only the head of the stairs when she was overcome by the flames. The father, on his return, succeeded in rescuing the two girls and then went into the room where the three boys were sleeping. He passed down to a police officer the bodies of his dead and dying sons. When he descended to the ground he collapsed and was rushed to the hospital in a serious condition.

L-31. LYNN, MASS., MAY 7, 1926. A plumber was at work in the basement of a dwelling house wiping a joint when the molten lead he was using spilled and struck him in the face. He was thrown upon a lighted blow torch. His clothes caught fire and, blinded, he staggered out of the cellar. Neighbors quick'y put out the fire and rushed him to the hospital where he died from his burns.

H-23399. ROCKFORD, ILL., MAY 28, 1926. Celluloid visor caps were being manufactured in a two-story frame and brick veneered building. Fire, presumably caused by a spark from a band saw used in cutting celluloid, ignited dust and shavings collected from the saw. Fire spread with great rapidity to the second floor where women were sewing caps together. There was only one means of exit from this room, which was an open stairway and this was soon in flames. Most of the employees either jumped from the windows or stepped from windows to the roof of a one-story addition. Five women were burned to death; they apparently became panic stricken, and being new employees did not know they could

escape from the building over the roof of the one-story section. Twelve employees were badly burned and injured by jumping from the building, one is not expected to live. The damage to the building amounted to only $500, but there was a loss of $10,000 on the celluloid stock.

H-23263. FORT DODGE, IOWA, APRIL 20, 1926. GARAGE. Severe burns sustained while he was working about his automobile resulted in the death of the owner of the car. He was attempting to start the car when a backfire occurred and ignited gasoline which had leaked out of the carburetor. His clothing was ignited and the garage caught fire. Alone at the time he was unable to extinguish the fire in his clothing and before help reached him his clothes were almost destroyed. He was taken to the hospital where he died the next day.

H-23292. BOSTON, MASS., MAY 2, 1926. APARTMENT HOUSE. A fire, which apparently started in the front stairway on the second floor from either careless use of matches or cigarettes, spread up the stairway so rapidly that the escape of a family of three people on the third floor was cut off. The deaths were attributed to inhalation of smoke. The father and mother had evidently attempted to save the son, as the firemen found their bodies with the boy near the window of the parents' bedroom. About sixty other tenants were rescued or escaped by jumping, and of this number two were seriously injured when they fell or jumped two stories from the window ledges of the fifth floor to the roof of an adjoining building. The fire also extended to the first floor but was prevented from entering the basement by one sprinkler head in the stairway operating and checking the spread of the fire in this direction.

L-34. WOLFVILLE, N. S., MAY 6, 1926. A woman was kindling the kitchen fire with kerosene when the can "exploded." She was so badly burned that she died a few days later. Her husband in attempting to subdue the flames was also badly burned.

L-37. BALTIMORE, MD., MAY 31, 1926. Efforts to save the manuscript of a book cost the lives of four people. The mother, her invalid son and a maid were trapped on the second floor of the home and all attempts of the firemen to rescue them were futile. The father was rescued from the roof of the sun-parlor where he dropped from a window encircled in flames. He died the next day in the hospital.